# The Journal of Bone & Joint Surgery

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**For the British Orthopaedic Association**

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The Journal of Bone & Joint Surgery

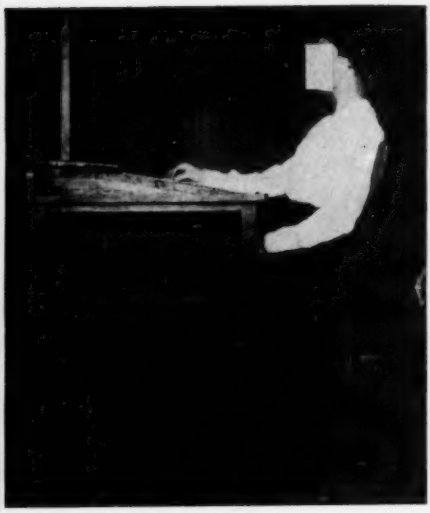
# THE IMPORTANCE OF CORRECT FURNITURE TO ASSIST IN THE BEST BODY FUNCTION, AS RECOGNIZED BY THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AND SMITH COLLEGE.

BY JOEL E. GOLDTHWAIT, M.D., BOSTON.

WITH the increasing consciousness that the right use of the body is desirable as part of the best health and general efficiency, it is not surprising that in 1915, when it became necessary to furnish the new buildings of the Massachusetts Institute of Technology, the matter of proper seating in class room and laboratory should have been given serious consideration. A highly technical institution such as this is, dealing with perfection of mechanical detail leading to the greatest possible conservation of mechanical energy, very naturally recognized the need of conserving the energy of the students through the proper adjustment of the human mechanism. To prevent the individual from breaking under the stress of professional responsibility was properly a part of such technical training, and since much fatigue or actual sickness is many times due simply to wrong use of the body, it was recognized that the seating problem was one of the first elements to attack. With this in mind, a committee was appointed by President MacLaurin, consisting of Mr. Horace S. Ford, the Bursar of Technology, Dr. Lloyd T. Brown, and the writer.

After much study, two types of chair, to meet the needs as presented, were approved,—one a "palette" arm chair for ordinary lecture room work and the other chair for work that involved much use of the seated body leaning forward, as working at a desk or table,—which were then manufactured by the firm of Heywood Brothers and Wakefield. The furniture used in the lecture halls, so-called "opera chairs," was not

FIG. 1.



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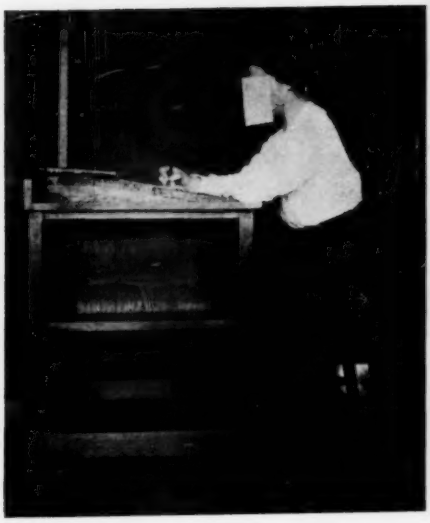

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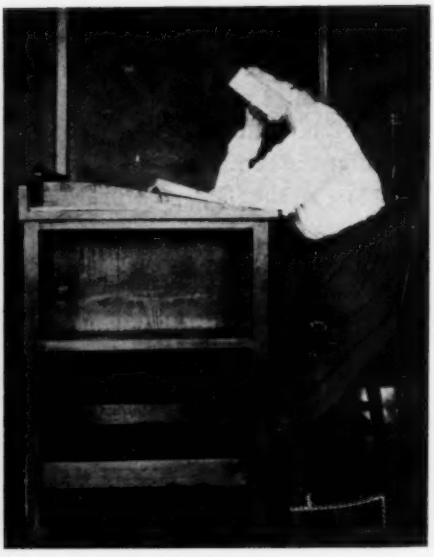

FIG. 5.

considered wholly satisfactory, but was finally approved as the best that could be planned at that time to meet the conditions as presented.

The "palette" arm chair was planned so that it would be possible for the body to be used with the least possible fatigue during lectures in which note-taking was expected. The proportions between depth of seat, height and shape of back, angle of back to seat, height of seat from floor, as well as the height and slope of the "palette," were all carefully determined after many anatomic studies involving individuals of different size and general proportion, as well as the best positions for avoidance of fatigue. In this latter consideration, the position and angle of the so-called "palette" was shown to be of the greatest importance, and that in most seats so equipped it is much too low as well as too flat. In the Technology chair, the "palette" is so placed that the student, in listening to a lecturer, would naturally sit with the body erect and with the head in the best position, while in writing it would not be necessary to change the body other than to incline the head slightly forward, as well as to lower the inclination of the eyes (Fig. 1). The usual droop of the body with the "breaking" at the waist line, as it is inclined forward to meet the needs of the ordinary "palette" arm chair, is unnecessary.

For the desk or bench chair (Fig. 2A) the proportions of height of seat, shape and inclination of back and other details were considered with the same care, the chief difference being in the depth and inclination of the seat. In the ordinary seat the depth is such that in leaning forward the weight is borne chiefly upon the posterior part of the thigh just below the middle, and this leads to such imperfect adjustment of the trunk and thigh muscles that it becomes extremely difficult not to bend at the waist line in leaning forward. This tendency is aggravated by inclination of the seat downward at the back, a feature that would be beneficial if the desire is for the erect seated position. With the shallow and nearly flat seat, the pressure upon the lower posterior thigh is removed, and in leaning forward the body rocks or balances upon the tuberosities of the ischia (the so-called hip bones). Under such conditions the bending at the waist requires effort rather than being the natural inclination, as in the other type of seat. The difference in the relatively flat seat of this chair and the inclination of the seat downward toward the back of the "palette" arm chair, where the erect position is expected, is clearly shown in Figs. 1, 2, 3, 4, 5. The natural position of the body taken as this chair is used, is shown in Figs. 3, 4 and 5, the forward inclination of the body taking place chiefly from the hip and not at the waist line.

Not only has this desk chair been used successfully at the Institute of Technology, but it has been accepted as the standard for seating in certain industrial plants, most notable that of the large clothing manufacturing concern of Joseph and Feiss at Cleveland, and is pictured in the bulletin upon "Industrial Posture and Seating" of the Department of Labor issued by the State of New York, April, 1921, as well as pictured with mechanical drawings (so that it can be easily copied) in the *Journal of Industrial Hygiene*, September, 1921, page 154.

Following the successful use of this furniture, and in keeping with the trend of education, which more and more realizes that it is desirable to have things done in the *best* way,—not carelessly,—when it became necessary to plan for the furniture for the student rooms in the new dormitories at Smith College, investigations were made which led to a committee being appointed to make recommendations. The committee was composed of Dr. Lloyd T. Brown, Dr. Robert B. Osgood (Professor of Orthopaedic Surgery, Harvard Medical School), Dr. Roger I. Lee (Professor of Hygiene, Harvard University), Dr. A. B. Emmons, 2nd (Director, Harvard Mercantile Health Work), Dr. Loring T. Swaim, with the writer as chairman.

As finally recommended, for the "study" or desk chair, the pattern adopted by the Institute of Technology and described above was selected, except that it was built on somewhat lighter lines. The chair is pictured in Fig. 2A, and in this, as well as with the chair designed for the Institute of Technology, no attempt at special adjustability was made. It was felt that whenever this was possible, experience showed that more often the adjustment was wrongly made than correctly, with harm rather than theoretical benefit resulting. A non-adjustable chair that would reasonably meet the needs of all types of individual was the task that was set for both committees. The ratio of height of chair to top of desk is fairly constant for all, and the difference in the length of leg is allowed in the shallow seat. With this it is perfectly possible for the individual with short legs to sit comfortably, since the thigh can be inclined downward fully thirty degrees before the posterior thigh rests upon the anterior edge of the chair, while with the individual with the long leg, the hip position is equally comfortable and there is naturally no disagreeable pressure upon the posterior thigh. With the shallow seat there is not the inclination to slide forward in the chair with the resulting "buckling at the middle" as is common with almost all chairs of the usual depth or backward downward inclination of the seat.

For the study desk (Fig. 3) it was agreed that a flat top desk is extremely difficult to use without bending at the waist line, and must

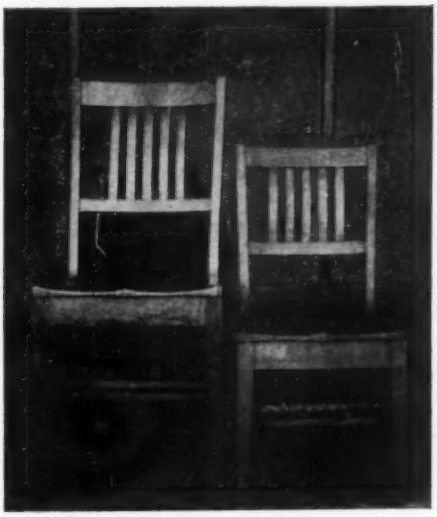

FIG. 2, a and b.

FIG. 6.

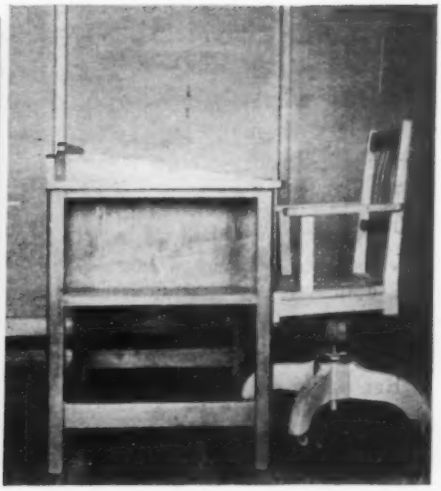

FIG. 7.

involve much change in the focal length of the eyes in covering a page for writing or reading. It was also agreed that most small desks are too low. The sloping top was finally adopted as not only inducing a better natural position in front of the desk, but in leaning forward there is not only very little tendency to bend at the waist line but the focal length for the eye between the top and bottom of the page is so nearly

the same that very much less eye adjustment is required than when the top of the desk is flat. The positions commonly assumed in reading or writing at the desk are shown in the illustration (Figs. 4 and 5). In these, as well as in the many tests that were made, there is very little tendency to bend at the waist line, which is the common posture with all flat top desks.

For the easy chair, it was finally decided that the natural physical requirements for the varying size and shape of the individual were best met by a "rocker" type. The balance of the rocker, the shape of the back, slope of seat, as well as height from floor, etc., were carefully studied, with the result as shown (Fig. 6). With a seat so proportioned there is very little tendency to slide forward in the chair, with resulting bending at the waist line, as is so commonly seen in the Morris and other types of easy chair, while the relief to muscle strain, which leads not only to the sliding forward in the seat but the other frequently seen positions of "slump" or "twist," is obtained by simply inclining the chair further forward or backward without changing the fundamental mechanics of the trunk of the body.

As still further evidence of the appreciation that furniture which encourages right use of the body is a responsibility that should be met as part of any college planning, the beds were selected so that the mattress would be relatively level and the spring not sag in the middle, as is so common with many inexpensive beds. During the periods of sleep the straight position of the body should be encouraged rather than made difficult, as is true of many of the beds on the market.

The furniture here described as used at Smith College was manufactured or provided by The Plimpton Scofield Company of Boston, and this concern has also made the Technology and Smith College desk chair in reduced size, this being considered the best school chair to meet the needs of children (Fig. 2B).

Recognizing the need of a suitable desk chair for executive use, the same firm has made, upon recommendation, a chair which fairly satisfactorily meets the needs. In this chair, as pictured in Fig. 7, there is very little tendency to slide forward in the seat with the undesirable buckling at the waist line, and the tipping mechanism is so adjusted that not only is the leaning backwards possible, but in leaning forward the front of the seat drops a little below the horizontal so that the weight continues to be borne upon the tuberosities of the ischia (hip bones) and is not received upon the mid or lower thigh, as is common in the ordinary chair. It is this latter feature which leads to the common "buckling" at the waist line with the resulting fatigue.

# A STUDY OF GAITS.*

BY CHARLES LE ROY LOWMAN, M.D., LOS ANGELES, CALIF.

AMONG the many subjects of interest to us as orthopaedic surgeons, the matter of gaits is one which should receive more than our mere casual attention. There are two phases to this subject, one dealing with diagnostic values, with which you are all familiar, and the other with the factors of appearance—efficiency and utility of apparatus—and the relation to social and economic states.

Surgeons in general are altogether too prone to trust to nature to work out her own salvation after the active surgical procedures are over and the patient has been given some massage, exercise, and passive motions. The analysis of limps and their improvement and correction may seem to some an added refinement, but from the patient's standpoint it is important, and there is always a possibility of improvement by training in nearly every case of limping if anything like reasonable co-operation can be obtained.

After an injury to a lower extremity, or following some reconstructive procedure, it is not wise simply to instruct the patient to begin walking without crutches or with only a cane, because he will invariably be influenced by the fear of pain or of falling, and by the feeling of weakness, both local and general, causing the assumption of an unnatural posture and gait. This is true, although there may be no mechanical blocking of the affected area, and even when there is no expectation of any residual or permanent limp.

In orthopaedic cases where there has been a limp previous to corrective procedures, it must be remembered that instructions to walk usually mean walking in the old way; because after years of an established gait there are no motor memory patterns of any other way of progression. Frequently the old feeling of weakness or fear of pain will make patients exaggerate the limp which was previously present. Walking is a complex act and is influenced by any factor that disturbs joint action, muscle action, joint alignment, or proper weight bearing. Bone and joint dis-

*Read at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

eases and injuries, paralyses, muscle contractures, and growth faults, comprise the chief sources of disturbances of locomotion.

For a number of years at the Orthopaedic Hospital-School Clinic, we have made it a definite procedure to assign these patients with limp to the gymnasium as soon as practicable after operative procedures or recovery from injuries affecting locomotion, with a definite prescription aimed at correction or modification of the faulty gait.

Gait can be definitely modified by correction of the faulty motor habits, and when definite mechanical factors leave a residual degree of uncorrectable limp, there can still be some improvement obtained by teaching the patient to maintain the best possible posture, and to cover up the worst features of the gait by assuming a certain mannerism which hides to a considerable degree the disability. For instance, the unsightly gait of the patient with old tubercular hip, healed in flexion and adduction, which requires the patient to step down on the affected side, with the pelvis thrust outward or backward and upward from the lordosis, is greatly changed by a subtrochanteric osteotomy, which makes a great improvement in general posture and position of the leg, but still leaves the patient with a stiff hip and a residual amount of necessary limp. A few weeks of training will make it possible for this patient to develop a special manner of walking which makes it seem unbelievable that the hip is actually ankylosed.

In brace-free cases with a shortened leg, with or without ankylosed knee or hip, we have found the design and adjustment of the shoe to be the most important single factor in affecting the gait and posture.

In the normal individual in walking after the stabilization of the knee by the action of quadriceps and hamstrings, the gastrocnemius and soleus are thrown on a tension and as they contract, the toe is thrust downward against the ground. The body is thus raised and propelled forward. As the body is raised on this leg, the opposite one is carried forward, and as it approaches the position to take the weight, the knee on the supporting side slowly bends, preventing a straight-legged upward thrust against the pelvis, thus allowing the body to be carried forward on a level. We should strive to obtain a similar action in our limp cases, *i.e.*, prevention of the abnormal pelvic and body movements.

In the shoe with high sole and heel the points of chief importance are: (1) the taper or roll of the sole, (2) the proportionate height of the heel to sole, and (3) the position of the heel on the shoe.

As to the first factor the shoe should carry the maximum thickness just back of the row of metatarsal heads, and should then have a taper forward whose curve of decreasing thickness depresses the forefoot and

raises the heel in an arc of motion simulating as nearly as possible the movement of the normal foot. In the normal foot the ground remains a fixed, constant factor, acted on by an inconstant factor which is in the leg; whereas, in a stiff leg, to keep from thrusting the hip upward and to maintain the movement of the body forward on a level, the fixed, constant factor must be in the straight leg, and the inconstant factor in the sole of the shoe.

The value and effect of much high class surgery can be greatly minimized, in fact almost wholly lost, if proper study and observation is not applied to the subsequent shoeing or bracing. It is bad enough for a weakened, paralytic leg to have to carry a heavy shoe in order to prevent pelvic tilt and a secondary scoliosis after a foot and leg has been re-aligned and stabilized, but it is worse to suffer the improper twists and thrusts of poorly designed corrective shoes. It is of little use to correct the injurious thrusts and stresses produced by the deformity, and then subject the parts to strains that are equally wrong after the deformity is corrected.

Too often the surgeon simply gives the bracemaker or shoemaker a prescription specifying the height of the heel and sole, to be made by them according to some fixed design which has been used regularly as a type. For instance, during my army experience, I cannot recall having seen one high sole or patten, of the many which came under my observation, that was not heavy, ungainly, and absolutely faulty in construction, its only evident purpose being to supply needed length for the short leg.

The relation of thickness of sole to that of the heel should be determined (1) by the amount of toe drop desired, (2) by the character of the step taken in relation to the propelling power of the rocker whose initial thrust begins at the thickest part of the sole, and (3) by the amount of actual muscular effort developed in foot and leg, especially in the gastrocnemius.

The shape and position of the heel also needs attention. There is a general tendency on the part of shoemakers to attempt to improve the appearance of such shoes by tapering the heel down from seat to base. This greatly increases the instability, although it lessens the weight somewhat. Generally speaking the base should be as wide as the seat, and by concaving the sides and back, and slanting the back a little forward, the same improvement in appearance is accomplished without losing stability. The heels should be extended on the base inward or outward from one-quarter to one-half inch in accordance with the need for a corrective lateral thrust to control valgus or varus.

The usual method of dropping the toes into rather marked degrees of equinus and allowing the insole to slant downward from the back of heel to toe is also faulty and a practice affected largely by makers of deformity shoes, the heel being built up the required amount, making it much longer on the back than on the face or breast of the heel. This construction allows the foot to slide forward in the shoe, making the dorsum and toes take the thrust, whereas, the correct procedure is to mold the shank up and keep the heel seat flat. In fact, putting a thickened pad on the insole in front of the heel aids greatly in preventing this slippage.

The adjustment of the heels on the shoes for astragalectomized feet, and those repositioned by transverse section with backward displacement requires considerable study and constant watching of the brace shop in order to get the best results. By following a suggestion received from Dr. Lord, a year or so ago, we have greatly improved the shoes for these cases, and ever since for prescription purposes have designated this heel in our clinic as the "Lord heel." After the weight bearing thrust on the foot has been altered by reposition operations, the heel in the usual position on the shoe is too far back. When it has to be over two inches high this posterior position makes too much weight in an unnecessary and useless place. It also makes the heel strike too soon, transmitting no thrust on the shank, but rather tending to break it, because the space between the heel breast and sole is too long. This position of the heel also undoubtedly assists in causing or increasing a tendency to rotate the leg out and produce a valgus thrust on the foot. To overcome these faults, Dr. Lord suggested that we try setting the heel forward more under the line of the tibia and cut off the excess of heel behind, sloping the back of the heel downward and forward. This produces a thrust upward on the shank and allows the heel seat to remain level. We have been grateful ever since for this helpful hint which I am passing on to you.

As to shanks, we have found that rigid ones are more lasting and least harmful to the feet. When the sole is thickened and the shank left flexible, a breaking strain is thrown upon the foot in the mid-tarsal region only. The strain is not distributed through the whole forefoot as it is in the sole of normal thickness. Furthermore the shoe breaks down and the necessity for frequent repair or replacement is a hardship on people of meagre means. Either the wood, cork, or leather can be made from one-half to three-quarters of an inch thick through the shank, or a metal bridge between sole and heel can be used to support the shank.

We have tried various materials in making the high soles, and are at

present experimenting with Balsa wood, which is as light as cork, but is so soft it will not hold a nail even an inch long. We have tried cementting the block between two leather soles and running a long screw down into the heel from the inside of the shoe. When willow wood is used it is important to bore holes in the block to lighten it. Metal extensions are not satisfactory because the leverage pulls the screws out of the leather, and so many screws have to be used that the shoe is very heavy.

In cases with short legs of the dangle type, the use of the Thomas ring splint, calipered into the high sole, has given the most satisfaction, particularly when the abductor group on that side is weak.

The film which I am presenting is shown, not only to illustrate the subjects of gaits, but to show a method of study of our cases at the Orthopaedic Hospital-School. After operative corrective procedures have taken place, one never has the original condition before one again, and in a busy clinic it is hard enough to have even the records show the exact deformities and positions of the feet—to say nothing of having any very exact recollection of their action. A note to the effect that the foot was originally in valgus does not give any clear idea of how the child used the foot in relation to faulty muscle action higher up. With motion picture records of the more important cases, studies of the original action in comparison with that subsequent to the various corrective procedures are of great value in determining further treatment.

# A CLINICAL STUDY OF THIRTY CASES OF MUSCULAR DYSTROPHY.

BY ROBERT V. FUNSTEN, M.D., IOWA CITY, IOWA.

*From the Orthopaedic Clinic of the State University of Iowa.*

THE cases of progressive muscular dystrophy here presented were examined at the University and Children's hospitals between the years 1916 and 1921. They have been studied chiefly from the following standpoints: clinical, metabolic, myotonic, and ergographic.

*Historical*[1].—It was not until 1850 that pseudohypertrophic muscular dystrophy, as a clinical entity, was described by Aran and Duchenne, although mention was made as early as 1709 of a similar syndrome. Shortly after this, Cruveillier put forth his theory of the spinal origin of this condition as a result of lesions which he found in the region of the anterior horn cells. This finally led to a heated argument between the neuropathic and myopathic theories. Charcot, Jaffroy, and Luys were the chief supporters of the neuropathic theory. Duchenne, who had advocated muscular origin, later came to adopt Charcot's views. Friedreich opposed the neuropathic theory. In 1878, Lichthein reported an autopsy in which there were no lesions of the spinal or peripheral nerves, but some signs of fat infiltration in the muscles. Nerve lesions have certainly not been a constant finding and in many cases in which they are reported there is reason to doubt the value of the observation or the correctness of the diagnosis. Erb,[2] in 1882, distinguished two types: the spinal atrophic type and the musculo-dystrophic type, and collected all the types into one group under the name "Dystrophia Muscularis Progressiva." This was subdivided clinically into two main groups:—

1. Progressive muscular dystrophy (infantile type).
   a. Hypertrophic form (Fig. 1):
      1. With pseudohypertrophy.
      2. With true hypertrophy.
   b. Atrophic form (Fig. 2):
      1. With primary facial involvement.
      2. Without facial involvement.
2. Progressive muscular dystrophy (juvenile and adult type) (Fig. 7).

FIG. 1.—Pseudohypertrophic muscular dystrophy, early stage.

FIG. 2.—Late atrophic stage of muscular dystrophy.

The first group begins early in life, almost always before the twelfth year, and often develops rapidly. Death often occurs between the fifteenth and twentieth years. There is weakness of the upper and lower extremities, usually hypertrophy of the calves and biceps at the onset, waddling gait, lordosis, and later atrophy and contractures. The second group begins around the twentieth year and lasts 20 to 40 years, with remissions. It starts usually in the shoulder girdles, often with hypertrophy of the biceps and atrophy of the serrati magni, supra- and infraspinati, and the pectoralis major. It may later extend to the lower extremity, with atrophy of the glutei and extensors of the foot, and with pseudohypertrophy of the calves. In neither the juvenile nor the infantile forms is the reaction of degeneration present, nor are there any fibrillary twitchings.[2] Erb reports pathologically an increase in the nuclei, normally and abnormally placed, with either an increase in the volume of the muscle fibers or else an atrophy, even to complete disappearance. Goodhart and Globus,[3] however, state definitely that we do not see true hypertrophy in the dystrophies.

Barsickow,[4] in 1871, made a study of an unusually interesting collection of cases. In one family the great-grandfather developed the disease between the twentieth and thirtieth year and was affected only to the extent of stiffness of gait and carriage. He lived to a ripe old age. In the five generations which composed the series an equal number of males and females were affected. In 17 cases the age of onset was as follows: five cases between 10 and 20 years, seven cases between 20 and 30 years, and five cases in later life. Lordosis, winged scapulae, and a waddling gait were prevalent. Out of 11 cases, nine lived 58 years or longer, one living for 80 years. No fibrillary twitchings were noted, but fatty infiltration of the muscles was encountered. This group of cases was evidently of the Erb juvenile type.

According to Timme,[5] Gowers in 1879 collected 220 cases from the literature. Of these, 190 were males. Some of Gower's conclusions are:

1. The disease is almost never known to be transmitted through the father.

2. The date of onset is important; the younger the age of the onset the poorer the prognosis.

3. Pes equinus is the most constant contracture.

4. The patient usually loses the power of standing at 10 to 12 years and death comes on from 14 to 18 years.

Landouzy and Déjèrine,[6] in 1885, described two cases. On one an autopsy was made. Not finding the spinal cord changes expected, they

considered this case as a clinical entity, differing from the Duchenne-Aran type. One of their two cases was classified as myopathic, facio-scapulo-humeral type, the other, showing no facial changes, as scapulo-humeral type.

No less striking than Barsickow's family collection is that reported by Timme. In four generations of one family there were 31 children in all. Of these, 14 were affected, eight males and six females. Five were examined by x-rays, four of these "showing distinct changes about the pineal glands." According to Timme the fifth showed an enlargement of the sella turcica. He thinks there is a definite relationship between the pineal glands and the disease, and as a check he examined 150 x-rays of the head in unaffected individuals and found only two with pineal shadows. He further supports his theory by the fact that the pineal gland is supposed to cease its function at puberty.

Brock and Kay[7] report a case of dystrophia adiposogenitalis associated with muscular dystrophy, showing shadows in the x-ray about the hypophysis.

Marina,[8] in 1908, reported an eight-year-old girl who had signs of pseudohypertrophic muscular dystrophy, who, after an interval of five years, returned for re-examination entirely well. He corresponded with Erb, asking his experience in this respect. Erb replied that he had seen one English girl who had recovered following menstruation, when normal glandular function was resumed.

In the recent literature there have been many cases reported from various aspects. The typical clinical picture is often complicated with other syndromes. Eulenberg[9] reported a case combined with acromegaly. Kaumheimer[10] reports a case in a child of five years after an attack of infantile paralysis. Milio[11] reports nine cases between the ages of six and eleven years where there was no hereditary factor, but in some cases there seemed to be a definite connection with acute infectious diseases. Collins and Climenko,[12] in a study of 50 cases reported a frequent association with other anomalies such as faulty teeth, general glandular enlargement, and high palate. Jendrassik[13] reports two cases of recovery following menstruation. He also cites the above-mentioned cases of Marina and Erb. Other cases of muscular dystrophy are reported by Rice,[14] Pirtle[15] and Bötner.[16] Reichmann[17] and Schuster[18] have written comprehensive articles with collections of cases. Finlayson[19] reports a case with onset at the beginning of menstruation. His case was quite definitely the facio-scapulo-humeral type and progressed rather rapidly.

*Etiology.*—In recent years some authors have brought out strong evi-

dence in favor of one or another of the endocrine glands. The trend of research seems to have gone almost entirely in this direction. The exponents of the pineal theory base their claims upon the similarity of symptoms to those in the proven cases of pineal tumor, *i.e.*, muscular weakness and fatigability followed by contractures and inability to walk, and occasionally involvement of the eyes due to pressure on the corpus quadrigeminum. The pineal shadows normally, they claim, occur only occasionally and only in adult life.

In Timme's five cases, four out of five showed pineal shadows; these cases were under 24 years of age. In the cases of pineal tumors reported by Pierce Bailey and Jelliffe[20] the symptoms resemble in many respects those of muscular dystrophy,—weakness of the lower extremities and waddling gait being among the characteristic features.

In his case of "adrenal insufficiency" Williams[32] reported lassitude, low blood pressure, and weakness of the limbs, especially in the morning. McAuliff[21] thinks there is a definite connection between the suprarenals and the secondary sexual characteristics of the female. Janney, Goodhart, and Isaacson,[22] in a study of nine cases, old and young, severe and light, think that muscular dystrophy is a result of dysfunction of the ductless glands affecting carbohydrate metabolism. In this series there were eight males and one female; there was definite familial tendency. Levi and Rothschilds[23] reported improvement of a myopathic condition from pituitary extract. Goodhart and Globus[3] in 1918 reported two cases of muscular dystrophy in which they found areas of cicatricial tissue in the heart muscle. Finding no "Aschoff bodies" and no other signs of infection they conclude that the changes were a part of the dystrophic syndrome.

*Ergographic Records.*—A. Gibson[24] has reported a case of familial "muscular infantilism" much resembling dystrophy, in an adult male; he was unimproved by thyroid or suprarenal therapy. The ergographic findings in this case, taken with Mosso's[25] ergograph showed that a small load could be raised almost indefinitely; however, a normal load could not be raised at all.

This seemed to be the case also in our ergographic experiments with the dystrophic cases. In children the ergographic record could be only a rough estimate, as it is difficult to get their entire coöperation. In one typical case, a boy, 10 years of age, the greatest weight that could be used was one-fourth kg. He was able to make a five-minute record, con-

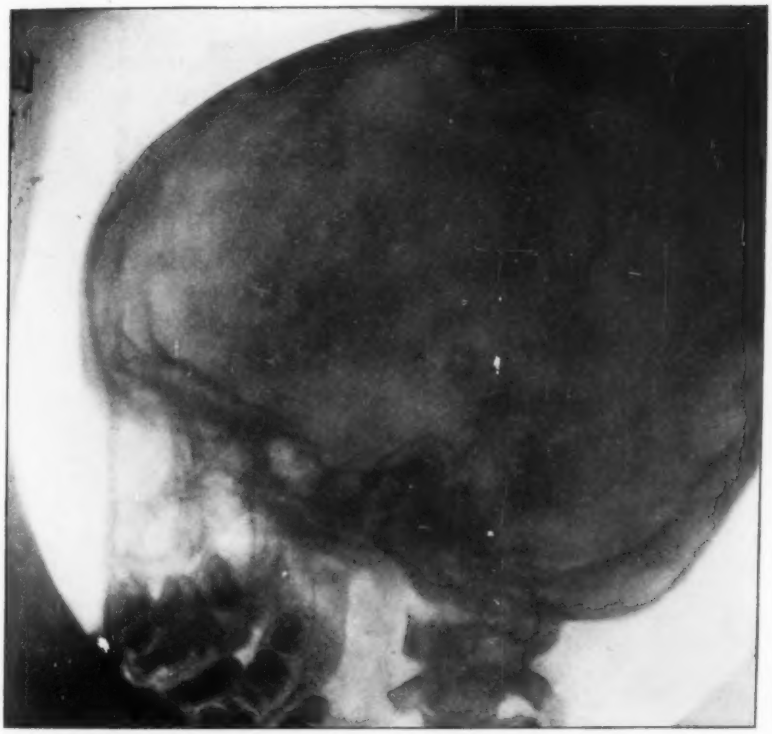

FIG. 3.—X-ray of the skull showing no definite pathology.

tracting every two seconds, with no marked variation in the height of the contractures.

A record was also made of a child with infantile paralysis involving the upper extremities. The thumb and index finger of the left hand were partially paralyzed, and the paralysis extended to some extent to the other flexors of the fingers. The record as usual was made with the middle finger; the same weight was used. In five minutes the tracing had reached a level of almost complete fatigue.

*X-Rays.*—The x-rays of the skull showed no definite shadows in the region of the pineal glands (Fig. 3); in two cases, however, there were enlargements of the sella turcica. X-rays of the long bones showed some thinning out of the cortex but no epiphyseal enlargements, and no gross atrophic changes (Fig. 4).

*Metabolism.*—McCrudden and Sargent,[26] Janney, Goodhart and Isaacson,[22] Brock and Kay[7] have reported a low amount of blood sugar in

myopathies. There was also in most of their cases a creatinuria and a low sugar tolerance.

Inasmuch as carbohydrate deficiency induces creatinuria, it has been argued that the faulty carbohydrate metabolism is responsible for the muscular changes.

FIG. 4.—X-ray of long bones showing mild atrophic changes.

We are indebted to Dr. R. B. Gibson,[27] of the chemical research laboratory of the University of Iowa College of Medicine, for his careful metabolic studies in ten of our cases. He is inclined to believe that the actual diminution of the amount of muscle tissue functioning is the condition inducing creatinuria, since he found creatinuria also in the cases of infantile paralysis which he studied. Yet, in the infantile cases the carbohydrate metabolism remained normal.

The metabolic findings may be summarized as follows:

1. Those due to muscle atrophy.

A. Creatinin.

a. Lower creatinin excretion in the urine, and in the blood the lowered creatinin coefficient (%).

B. Creatin.

b. Creatinuria (not present in normal individuals).

c. Recovery in the urine of creatin when fed.
d. Creatin in the blood.

2. Due to "endocrine disturbances."
   a. Low amount of sugar in the blood.
   b. Excretion of sugar in the urine when fed in amounts usually tolerated (lower sugar tolerance).

The eight cases of progressive muscular dystrophy in boys and two in adults were studied metabolically. The result of the investigation is, therefore, the increase of the output of creatin in the urine, on one hand, and the low sugar tolerance in cases of muscular dystrophy. Both of these factors seem to keep step with the progress of the muscular changes, and consequently it seems possible to judge the severity and malignancy of the process by the metabolic picture.

*Cases.*—Owing to the large number of cases we cannot at the present time give a detailed report, but instead the cases have been generalized into their respective groups. The group arrangements of Erb, and of Turner and Stewart,[28] in their text book of nervous diseases, do not differ essentially. We feel that the hypertrophic and atrophic types of the infantile form should not be strictly differentiated, as it appears that these two conditions may often follow one upon the other in the normal course of the disease. In this series of dystrophy cases there were 25 males and five females. The female cases do not seem to have any individual characteristics.

The average age was 13.5 years; oldest, 38 years; youngest, two years. The average age of onset was five years; oldest, 21 years; earliest, a few weeks after birth.

In looking into the hereditary tendency, there were in the group of cases examined, two striking instances. In one family there were four children, two boys (Fig. 5) and two girls; all developed typical muscular dystrophy at an early age. The oldest, now 11 years of age, is unable to walk. In another family the mother was married twice. By her first husband there were three boys and one girl. All the boys developed muscular dystrophy and died; one died in infancy, one at the age of eight years, and one at the age of 18 years. By her second husband there were two boys and two girls. All the girls are living and show no evidence of the disease. Both boys were presented here for examination and showed typical muscular dystrophy, and one has since died of influenza. In two other instances there were respectively cousins and uncles and

FIG. 5.—Brothers with muscular dystrophy, one early stage, the other a later stage.

FIG. 6.—Very typical attitude in the most common forms of progressive muscular dystrophy.

brothers of the mother affected. There were four instances of either extreme nervousness or insanity on the maternal side. The rest of the cases were isolated ones, almost invariably only children (Fig. 6).

*Groups.*—Of the 30 cases, four were of the juvenile form (2), coming on at the ages of 12, 15, 18, and 21 years, and usually starting as the upper girdle type. The other 26 were of the infantile form (1), and more frequently started as the girdle type, the weakness being noticed in the lower limbs, with difficulty in getting up from the floor and in going upstairs. Stumbling, lordosis, waddling gait, and loss of reflexes were the characteristic symptoms.

Twenty-four cases were of the infantile type, either hypertrophic or atrophic form. In this group of infantile cases, seven were tested at intervals of two to 12 months by means of Lovett's[33] spring balance test; some showed a definite progress of the paralysis; others showed no change after six months, one case after 12 months. One case in this series, a boy nine years of age, seen two years after onset, showed much improvement and a definite gain in strength after two years of observa-

tion. The condition seems now to be arrested and the mother reports that he is making a daily gain in strength and she believes him cured. In two other cases, records were made on admission to the hospital, after three days of rest, and then after one day of exercise. The exercises consisted of walking up and down stairs. The records showed that after rest in bed for a few days the muscle action was distinctly weaker than on admission. After exercises all day there was a slight increase over the records after rest. However, in neither of the cases was the rise great enough to equal the original spring balance test on admission.

There were two cases of the facio-scapulo-humeral type. Seven cases were beyond the walking stage and had various contractures.

*Treatment.*—Twelve cases were treated for two weeks to three months with various glandular extracts (pituitary, adrenal, parathyroid, and pineal) without any appreciable effect. Seven cases were treated with calcium lactate and 11 with massage and exercises (either with or without glandular treatment). We feel that calcium lactate is of some benefit. Pemberton[29] reports a marked loss of calcium in the blood in two cases. Rosenbloom and Cohoe,[30] reporting a case of myatonia, think that the decrease in the calcium may play an important rôle in the muscular weakness. Apparent retardation of the progress seems to have been accomplished by means of autohemic serum.

Twelve of our cases were slowly progressive, eight moderately, and nine rapidly progressive. Wassermann tests made on 14 cases were negative. The microscopic blood picture was normal in six cases examined. The reflexes were either absent or greatly diminished in all cases, with the exception of the cremasteric and abdominal reflexes, which as a rule were present. Microscopic examination of muscle, made in four cases, showed the fibers to be pale, with diffuse areas of granular degeneration and vacuolization. There were also areas of fat infiltration between the muscle fibers. The striations were present except in a few places where complete degeneration had taken place.

Of the 30 cases, 23 are known to be living, three are dead from intercurrent diseases, and four have not recently been heard from. In none of the cases was there any tangible connection between the onset of the disease and acute infectious diseases. In no case was the onset acute.

The following two cases were of particular interest:

Case 1. O. Smith, a man 38 years of age, came to the hospital for relief of his weakness (Fig. 7). This he first noticed when 18 years of age in the muscles of his right forefinger; gradually the weakness extended to his shoulders and later to his hips. As the disease progressed

FIG. 7.—Adult case, of the adult form, duration 20 years.

the calves became hypertrophied. He had great difficulty in going up and down stairs. Later, there was a waddling gait, lordosis, and marked atrophy of the muscles with protrusion of the shoulder blades. In spite of his weakness he could when once on his feet walk for long distances, and do a certain amount of work. Upon examination he was able, with great difficulty, to get up from the floor. This he did in a way very characteristic of the dystrophy cases. He walked somewhat on his toes, but the foot did not assume a position of equinus when he was standing. There was marked atrophy of the muscles of the arms, shoulders, chest, and thighs, particularly the serratus magnus, supra- and infraspinatus, biceps, and triceps, intercostals, glutei, and hamstrings. There was some hypertrophy of the calves, but facial muscles were not involved. All reflexes except the cremasteric and abdominal were absent. His metabolic picture was characteristic of a slowly progressing muscular dystrophy; the blood was normal and the Wassermann negative. Unfortunately no radiograph of the head was made. He was given a reinforced corset for support. He reported two years after examination that his condition was about the same.

CASE 2. Oscar S., 15 years of age, was admitted to the hospital for

paralysis, giving the following history: The condition was first noticed when he was four years old. At that time he was able to walk about and use his hands. However, since then he has gradually become weaker, and to add to his difficulties, has also become very obese. For the past three years he has not been able to walk.

The examination shows him to be an extremely obese boy, with an intelligence almost normal; the pubic hair is missing, and the sexual organs small. His weight is 250 pounds and he is unable to stand. The calves are enlarged and hard; he is unable to flex his knees and can scarcely flex his elbows. The reflexes are entirely absent. The fat distribution is very extensive on his back and neck. The patient presents a combined picture of dystrophia adiposogenitalis (Fröhlich's syndrome; Ebaugh and Hoskins[31]) combined with progressive muscular dystrophy. The x-ray shows the sella turcica irregular and indefinitely outlined. The anterior-posterior diameter of the sella was 14 mm.; the superior-inferior diameter 9 mm. Of the muscles, the calf muscles are the strongest, being approximately one-fourth their normal strength.

The patient died two months after admission, of influenza, and an autopsy was obtained. The anatomical diagnosis was as follows: Double lobar pneumonia; septic splenitis; fatty infiltration of the liver; enlarged thymus; enlarged parathyroids; edema of the brain; cyst of the hypophysis; replacement of skeletal muscle by fat tissue, and muscular dystrophy—pseudohypertrophic. No gross pathology of the pineal gland was found.

The additional microscopic diagnosis was as follows: Edema of the heart; focal necrosis of the adrenals; ingrowth of fat tissue into the parathyroids; healed tuberculosis of the lymph nodes, and engorgement of the anterior lobe cells of the pituitary body with hyaline droplets. In regard to the parathyroids, Dr. Medlar, the pathologist, makes the following note: "If these structures were accessory thyroids, the parathyroids were so small that they could not be detected in gross examination."

*Summary.*—In summarizing it seems very hard at the present time, either from the evidence presented by many authors, or from our own observations, to draw definite conclusions as to the etiology of the progressive muscular dystrophies. If we allow ourselves to be influenced entirely by the theories of endocrine origin we find many stumbling-blocks. It is hard to believe that a cystic tumor or other pathology of one of these glands can always locate itself in just the place to cause repeatedly the identical or almost identical clinical entity. The evi-

dence introduced in this respect does not always seem to be entirely sound. On the other hand, the recoveries reported in the literature and in our own series seem to be beyond question. There is not in progressive muscular dystrophy the low fatigue coefficient, within physiological limits, that one would expect to find. The muscle fibers which remain unaffected from the disease seem to be acting to the extent of their normal limit. But there seems to be not "enough ammunition to go around." Is it a matter of waste product elimination? Are a part of the muscle fibers in their physiological capacity of glycogen builders and storehouses, or as secretors of sarcolactic acid and carbon dioxide, failing in their work?

It is generally conceded that there is a low amount of blood sugar, and that sugar when fed is rapidly excreted. Has something happened to the muscular substance which should activate the transforming enzyme? We need more autopsies; we need more pathological studies; more chemical studies; and we need more research by men who go into their work with a good substantial knowledge of what has already been said and done on the subject.

In making this synopsis of our cases we have come to the realization of its possibilities, and the meager work which we have presented will be followed up in the immediate future by a more thorough, and we trust, more enlightening series of experiments.

I am indebted to Dr. Steindler, in charge of the Orthopaedic Service, for the privileges extended me in the use of the cases and for his cooperation and valuable advice.

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# THE TYPES OF TUBERCLE BACILLI CONCERNED IN SURGICAL TUBERCULOSIS.*

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I FEEL that you will expect me to begin with an apology! For I am reading a paper dealing with bacteriology and am no bacteriologist! But though the experimental work has been done by others, much of the material has come from cases of joint and bone tuberculosis under the care of members of our Association and in particular of Sir Henry Gauvain. Facts of great interest have resulted from this work, but there is still much to be found out. The papers dealing with this piece of research have been published in various journals which I fear many of us do not find time to read, so the data and conclusions may be of new interest; further sources of material may be made available for a continuance of the research;† so that I feel that no apology is really needed.

My own interest in the matter is of very long standing. It has been revived of late in that the thorough organization of after-care has made it possible for us to keep in touch with cases for many consecutive years so that opportunities of recovering material from cases at long intervals are likely to arise. I feel that the subject is of interest to all dealing with bone and joint surgery, and that some of the data are suggestive as to treatment.

## EARLY INVESTIGATIONS.

Long before methods of distinguishing the human from the bovine bacillus existed there was evidence that infection from milk was a cause of tuberculosis in the young.

Within a very few years of Koch's discovery of the tubercle bacillus,

*Read before the British Orthopaedic Association, October 20, 1922.

†Dr. A. S. Griffith, Field Laboratories, Milton, Cambs., is carrying on the research. He is particularly anxious to obtain further material from cases previously found infected with atypical strains, from cases of lupus, and tuberculous material removed during laparotomy.

30 per cent. of dairy cattle examined in Edinburgh were found tuberculous, and tubercle bacilli were found in 16 per cent. of samples of milk.

Fraser in 1912,[1] and Mitchell in 1914[2] published papers on the rôle of bovine bacilli in bone and joint and cervical gland tuberculosis of children. Fraser compared bottle fed with breast fed babies and found:

TABLE 1.

| | Cases | Bovine | Human | Mixed |
|---|---|---|---|---|
| Bottle-fed | 43 | 35 | 3 | 3 |
| Breast-fed | 26 | 7 | 19 | — |

and comparing infants from families of which a member was known to be infected with tuberculosis with those from families without such known infection:

TABLE 2.

| | Cases | Bovine | Human |
|---|---|---|---|
| Infants from infected families | 21 | 6 | 15 |
| Infants from apparently uninfected families | 46 | 43 | 3 |

The results of Fraser and Mitchell show an unusually high proportion of "bovine" infection when compared with those obtained more recently by Eastwood, F. Griffith and A. S. Griffith, by their standard methods (shortly to be detailed).

However, the relative proportions of the two types seem to vary a great deal in different parts of the world. "Bovine" tuberculosis seems very rare in Paris and common in London and New York.

## MORE RECENT METHODS OF CLASSIFYING TUBERCLE BACILLI.

At Cambridge a systematic series of tests have been applied to various strains of bacilli from cases of surgical tuberculosis by A. S. Griffith, F. Griffith, and Eastwood.[3]

The bacilli were recovered either direct from the specimen (aspiration fluid, sinus discharge, granulation tissue, etc.) or through a guinea pig.

**A. CULTURAL TEST.** Cultures are raised on egg medium and then tested on bovine serum and glycerine media (serum, agar, potato or broth).

"Human" (1) "Eugonic" on all media.

(2) Wrinkled layers on agar, potato, and broth.
(3) Pigmented on suitable bovine serum.

"Bovine" (1) Dysgonic. Three grades of growths, but best growing bovine strains fall distinctly below the human in luxuriance.
(2) Not pigmented on bovine serum.

B. ANIMAL TEST. Rabbits (inoculated subcutaneously).

"Human" *Virulence low—rabbit never dies within 3 months* from tuberculosis.
Spleen and lymph glands seldom affected, lungs not enlarged, isolated tubercles or tuberculous masses.

"Bovine" *Virulence high—rabbit almost always dies within 10 weeks.*
Generalized tuberculosis.
Spleen and lymph glands generally affected.
Lungs—voluminous, studded throughout with tubercles or confluent tuberculous masses.
Kidneys beset with tubercles and nodules.

A. S. Griffith collected all the cases of human tuberculosis that have been investigated by identical methods in Great Britain and reported. The total number is 1068—of these 395 are cases of bone and joint tuberculosis and the figures are as follows:

TABLE 3.

Cases of Bone and Joint Tuberculosis.

| Age period | No. of Cases | Human | Bovine | Atypical | Percentage Bovine |
|---|---|---|---|---|---|
| 0 - 5 | 84 | 57 | 25 | 2 | 29.76 |
| 5 - 10 | 167 | 121 | 42 | 4 | 25.15 |
| 10 - 16 | 90 | 77 | 8 | 5 | 8.8 |
| Over 16 | 54 | 48 | 3 | 3 | 5.5 |
| All ages | 395 | 303 | 78 | 14 | 19.7 |

There are two main types—the "standard human" and "standard bovine" and a group of atypical strains. The "bovine" bacillus is responsible for a large share, varying between 25 per cent. to 60 per cent. of bone and joint tuberculosis during childhood; as the age period of the attack advances "bovine" infection becomes less frequent and is rarely met with in bone disease after 20. The "human" bacillus, while taking a considerable share of the responsibility at all ages, covers almost

the whole field in adult life. "Atypical" strains account for a very small number of cases.

The progressive lessening of the proportion of cases from which bacilli giving "bovine" type reactions are obtained would seem to indicate either that increasing age gives increasing resistance to bovine bacilli and that adults are immune, or that the bovine bacilli, which almost always gain access to the body in early childhood, have, in the course of years, lost their bovine characteristics.

Calmette[4] says that there is only one species affecting mammals and that it is adaptation of the bacillus to the human or bovine host that gives rise to the two main varieties with which we are concerned. One naturally jumps to the conclusion that the "atypical" group represents bacilli of bovine origin in process of adaptation to their human environment, and that this group might well be named "transitional." And *yet*

(1) such an adaptation has never been proved experimentally;

(2) all three groups of bacilli conform closely to a standard—from whatever source they are recovered, and at whatever age—

(3) in the few instances where the "atypical" bacillus has been recovered from a case at two periods with a distinct interval (in one case 19 months) the cultural and virulence characteristics at the early and later periods have proved identical.

Although the experimental evidence is as yet entirely negative, I feel that further cultural and virulence tests of "atypical" bacilli should be carried out repeatedly over as lengthy periods in each case as possible. It may perhaps still be possible to recover bacilli from some of the "atypical" cases recorded by Eastwood and Griffith; if so, a record of their present test characters would have great value.

Much clinical interest lies in this possibility of the transition of the infecting strain from "bovine" to "human" type within the period of its sojourn in one human host. Does the "bovine" bacillus, which so constantly penetrates the membranes of the infant's body with cow's milk, and which is so often responsible for bone and joint tuberculosis during childhood, change in character in course of time to the "human" type? And, if so, do these bacilli of human type but bovine origin share with the bacilli derived directly from a human source in the responsibility for all the manifestations of tuberculosis in later life?

In Table 4 A. S. Griffith gives the number of each clinical variety of case investigated and the relative frequency of the two standard types and atypical varieties of tubercle bacillus respectively in each set of cases:

TABLE 4.

| Bone or Joint | No. of Cases | Human | Bovine | Atypical |
|---|---|---|---|---|
| Hip | 50 | 43 | 6 | 1 |
| Spine | 28 | 17 | 8 | 3 |
| Knee | 14 | 13 | 1 | — |
| Ankle | 5 | 5 | — | — |
| Multiple | 28 | 22 | 5 | 1 |
| Other Bone or Joint | 10 | 7 | 3 | — |
| Total | 135 | 107 | 23 | 5 |

He emphasizes the constancy of the group characteristics.

"From several of the cases more than one strain of culture has been investigated, and in each case the different strains were found to be identical in cultural characteristics and virulence."

"Two cases in my series had been previously and independently investigated by Eastwood and F. Griffith, one.....yielded to each investigation a fully virulent 'bovine' culture. The interval between the taking of the two samples was 9 months. In the other ('atypical') case the cultural and virulence characteristics were, so far as they could be compared, identical—the interval between taking of material being about 19 months."

Griffith says that the "atypical" (or dysgonic human) bacilli are so constant in their biological characteristics as to constitute a distinct variety of tubercle bacillus. They can be readily distinguished by cultural tests from both "human" and "bovine" types[5], and by virulence tests from the "bovine" type.

In another paper evidence is given of the prolonged persistence of the "bovine" characteristics in cases of genito-urinary tuberculosis.[6] One case gave "bovine" cultures in August, 1912, December, 1912, February, 1913, and October, 1913. All were typically bovine and "cultures from the later specimens showed no indication of modification in the 'human' direction." Another case (age 20) gave a "bovine" culture and had a history of tuberculous glands (with scars) *in childhood.*

From the various papers mentioned I have picked out the cases of spinal tuberculosis from the others, noting the age and the type only, in order to arrive at an estimate of the relative age incidence of the disease in the case of the respective infections. In considering these figures it should be realized that the average ages are of relative value only. The research at Cambridge was carried out from material dispatched from a number of sources and mainly came from special hospitals for the treatment of *children* suffering from surgical tuberculosis. All ages are therefore not equally represented.

Of 130 cases of tuberculosis of the spinal column the average ages were:

Human = 11.14 Bovine = 5.8 Atypical = 15.9

In other tables it is shown that the "bovine" bacillus as a cause of bone and joint tuberculosis disappears after the age of 20.

A very interesting and suggestive comparative table is that of 108 cases of cervical gland tuberculosis and 45 of lupus. In this table the proportion of "bovine" infection is very much higher, *viz.:*

TABLE 5.

| Age period | 108 Cases Cervical Gland. "Bovine" | 45 Cases Lupus. "Bovine" |
|---|---|---|
| 0 - 5 | 86.6% | 63.6% |
| 5 - 10 | 63.3% | 52.6% |
| 10 - 16 | 33.3% | 50.0% |
| Over 16 | 25.64% | 22.2% |
| | 46.3% | 48.9% |

and in "scrofuloderma" the figures are similar. But in both these skin conditions the large majority of strains do not give typical virulence test results, 36 out of the 45 strains, both human (18) and bovine (18), showing very marked reduction of virulence.

## THE OCCURRENCE OF STRAINS OF THE TUBERCLE BACILLUS OF LOWERED VIRULENCE.

In only 46 of the 1068 cases already quoted do the strains of tubercle bacilli show any clearly marked alteration of virulence. And in 44 out

of the 46 the cultures were derived from cases where the skin was the main lesion. The only non-cutaneous lesions providing a strain of reduced virulence being, (1) a muscular or intermuscular abscess of the thigh from a girl, aged 12, in whom a tuberculous cervical gland yielded a culture of standard virulence, and (2) a cervical tuberculous gland.

TABLE 6.

Data from Table—Giving the 1068 Cases

| | | Human | | Bovine | |
|---|---|---|---|---|---|
| | No. of Cases | Typical | Attenuated | Typical | Attenuated |
| Lupus | 45 | 5 | 18 | 4 | 18 |
| Scrofuloderma | 52 | 28 | 4 | 16 | 4 |

In lupus 36 out of 45 are attenuated, in scrofuloderma only 8 out of 52.

A. S. Griffith (*Journal of Pathology and Bacteriology*, Vol. xxiii, No. 2, Feb., 1920) discusses this most interesting matter, and states:

"The occurrence of attenuated strains of tubercle bacilli in scrofuloderma is of great interest and importance. Hitherto attenuated strains of tubercle bacilli have been found....only in lupus lesions, a tuberculous cervical gland, and an intermuscular abscess. In lupus, which is caused by tubercle bacilli of human and bovine type in about equal proportions, the great majority of the strains have shown attenuated virulence. The presence of attenuated strains in the lesions of another variety of skin tuberculosis is, therefore, not surprising, and the difference in proportion of attenuated to standard strains in the two diseases is probably related to differences in the situation and duration of the tuberculous lesions. In scrofuloderma the tuberculosis affects primarily the subcutaneous tissues or the deeper layers of the skin and is of relatively short local duration, whereas in lupus the lesions are *more superficial and of greater* chronicity."

The attenuation of tubercle bacilli is apparently then the rule in skin lesions. Is it not possible that there may be some very real relation between this reaction between the skin and the bacilli in lupus and scrofuloderma and the beneficial action of the sun and the wind in treatment? And may not this function be developed and used to a much greater degree?

CONCLUSIONS.

1. The bacilli fall into three groups:
   Human,
   Bovine,
   Atypical (comparatively small but quite distinct).
2. The proportion of cases for which the bovine bacillus is responsible

varies to some extent with regard to the site of lesion; *e.g.*, they play a larger part in gland than in bone and joint tuberculosis, but the variation due to age differences is much more marked; their responsibility is great during the first five years of life and disappears rapidly after the age of 16.

3. The various strains of bacilli in each group give consistently the reactions characteristic of that group. Strains of bacilli giving intermediate reactions are almost unknown.
4. In no instance have bovine or atypical strains when investigated at intervals in the same case shown change of cultural or virulence reactions toward the human. Further investigation at longer intervals is needed.
5. There is no experimental evidence that the atypical group is composed of bacilli whose characteristics are changing from bovine to human type as a result of human environment.
6. Tubercle bacilli of lowered virulence are found exceedingly rarely except in connection with tuberculous lesions involving the skin; on the other hand in cutaneous lesions bacilli of lowered virulence are common, and this is most marked in lupus, a condition where the more superficial layers of the skin are involved over long periods. This is a further reason for our belief that the skin is an organ particularly valuable in the contest between man and the tubercle bacillus. Scarification and inunction, or intradermal inoculation of tuberculin may prove of exceptional benefit in the treatment of all forms of tuberculosis.

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[4]L'infection bacillaire et la tuberculose chez l'homme et chez les animaux.
[5]Loc. cit., p. 70.
[6]Eastwood and Griffith, Journ. of Hygiene, Vol. xv, p. 310.

# ABNORMALITIES OF THE FIFTH LUMBAR TRANSVERSE PROCESSES ASSOCIATED WITH SCIATIC PAIN.

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INASMUCH as the rôle of malformation of the transverse processes of the fifth lumbar vertebra in causing pain in the low back and legs is attracting so much attention, it would seem to be of interest to present some observations on a series of nine cases, seven of which have been operated upon.

Dr. Z. B. Adams, in 1910, was the first to suggest that these abnormal processes might have a pathological significance in cases of so-called sciatic scoliosis. Since then numerous cases have been reported in the literature, but there is still considerable difference of opinion as to whether the symptoms associated with the abnormal transverse processes are really due to their presence. There is a still greater difference of opinion as to the treatment of the condition.

These abnormalities are frequently found in x-ray examinations of cases in which there are no symptoms that would suggest their presence. On the other hand, they may be found associated with symptoms for which they may account.

These cases nearly all resemble each other rather closely, so that for the purposes of study one case will be given in detail, and the others briefly.

CASE 1. B. H., aged 24 years, married, mother of four children. Entered Cook County Hospital, February 16, 1921.

Complaint: pain in lower back and left leg.

Back pain began five years ago during first pregnancy. It was dull and aching, located in the lower lumbar muscles and upper part of the left hip just outside the sacro-iliac joint. This pain has persisted almost constantly ever since, and was increased during each pregnancy. During her last pregnancy, seventeen months before, she began to have sharp shooting pains down the back of the left thigh and calf. These pains were not constant, but were brought on by walking, stooping, or lying on the right side. Latterly there had been some numbness on the

dorsum of the left foot. At times there was a "crawling" sensation in the same region.

Examination showed a moderate list of the entire spine to the right, with slight flattening of the lumbar curve. There was moderate tenderness over the lower portion of the left lumbar muscle. The spine itself was flexible, but forward bending caused pain in the left hip, localized about two inches outside the sacroiliac joint. The spine could not be brought beyond the vertical to the left. Any attempt to do so caused pain down the back of the left thigh and in the calf. Rotation of the lumbar spine to the left caused the same pain. The muscles of the left thigh and leg felt distinctly more flabby than those of the right, though the measurement was the same. The left peroneal and tibialis anticus muscles were decidedly weaker than the right. Sensory changes were not marked. Light touch and pain were localized well. The temperature sense was normal. Just behind the toes on the dorsum of the foot there was an area where light touch caused formication.

In standing, the weight was habitually carried on the right leg, and the left side of the pelvis sagged. She walked with a slight, left-legged limp. Wassermann test negative.

Stereoscopic x-ray plates showed a large fish-tailed transverse process on the left side with the upper portion definitely in contact with the ilium. The process on the right was normal. No arthritic changes were seen.

February 24, 1921: operation. Transversectomy, left fifth lumbar. Upper portion of process removed. It was definitely impinging on the crest of the ilium. No bursa was found.

The patient had considerable postoperative pain, but no paralysis. She was kept in bed for three weeks, by which time the pain had disappeared, and she was able to walk without a limp. The list of the spine had also cleared up. Postoperative x-ray showed that the process was not completely removed, the lower portion being left. The patient reported recently by letter that she had had no further trouble, and that the backache had not recurred.

Case 2. W. S. Male; age 33 years; laborer.

Complaint: pain in right leg, hip, and low back. Duration, seven months; came on gradually; noticed first in back and hip. Then became worse and ran down back of thigh and calf. Has been unable to work. Pain is increased by motion of spine.

Examination: Marked list of spine to left; cannot be brought to

vertical. Tenderness in right upper buttock and lower lumbar region. Rectal examination negative. Wassermann negative.

Stereoscopic x-ray plates showed long hypertrophied transverse process of right side of fifth lumbar vertebra, in contact with the ilium. April 30, 1921. Operation: transversectomy, right fifth lumbar. The process was found in contact with the ilium, and a very strong, fibrous cord extended from the tip of the process to the inner face of the ilium.

The patient had considerable postoperative shock, and the pain in the leg persisted for about two weeks. Postoperative x-ray showed incomplete removal of the process, the lower portion remaining.

Exercises and occupational therapy were begun at the end of two weeks, and the list of the spine cleared up in about two months. The spinal motions became normal.

The patient reported for observation six months after operation, and was working then without trouble. X-ray taken at that time showed the remaining portion of the process more plainly than the first postoperative x-ray. It may represent a partial regeneration of the process.

Case 3. A. B., male; age 28 years. Collector.

Complaint: pain in low back, right upper buttock, and back of right thigh and calf. Began in back and buttock about nine months ago. Back was strapped with adhesive plaster, with slight relief. Recently the pain has localized itself in right sciatic region also. This has been severe enough to prevent him from working.

Examination: All motions of lumbosacral region limited, and caused marked pain in right sciatic region. Spine is straight. Lumbar curve slightly flattened. Tenderness about two inches outside the sacroiliac joint on right side.

X-ray showed complete sacralization of both transverse processes of the fifth lumbar vertebra. Patient was kept in bed for three weeks, with no relief.

On November 21, 1921, tonsillectomy was done by Dr. McBride. On December 5, 1921, patient was able to return to work, and has had no further back or sciatic trouble, though his occupation requires much walking, and involves carrying a weight of fifty or sixty pounds most of the day.

Case 4. J. S. Male; laborer; age, 39 years.

Complaint: Pain in lower back, left upper buttock, and back of left thigh and calf. Duration in back: eight years, with some intervals of relief. In sciatic region for one year constantly.

CASE 3.—Complete sacralization of the fifth lumbar transverse processes. Symptoms relieved after tonsillectomy.

Examination showed marked list of the spine to right with flattening of lumbar curve; three-fourths inch atrophy of left thigh. Some weakness of anterior tibial group of muscles. Could not correct position of spine to the vertical. All motions caused pain in the left sciatic region.

Rectal examination, negative. Blood, spinal fluid, and Wassermann negative. X-ray showed elongated, club-shaped transverse process on left side of fifth lumbar vertebra. It was not in contact with ilium as patient lay with spinal column drawn toward the right.

November 6, 1921. Operation: transversectomy, left fifth lumbar. The process was found in contact with the ilium, and a tough fibrous

CASE 4.—Showing the marked list of the spine to the right, with the left transverse process not in contact with the ilium. At operation it was in close contact.

cord extended from its tip to the ilium. The patient had very little postoperative reaction, and the sciatic pain had disappeared by the fifth day, and he was walking a little on the tenth day. He was put on exercises in three weeks, and the lateral curve of the spine disappeared in about six weeks.

He was seen five months afterward and was working as a machinist, and had none of the old trouble.

CASE 5. F. S. Male; negro; laborer; age, 41 years.

Complaint: Pain in left lower back, upper buttock, and back of left thigh and leg. Duration, six years. Onset was very sudden and severe, with pain shooting down the leg from the hip. Had considerable diffi-

CASE 4.
FIG. 1.—Before operation. Maximum voluntary correction of scoliosis.

CASE 4.
FIG. 2.—Two months after operation.

culty in walking at the time. Was in the hospital nine months at that time. Pain in the back has persisted ever since. Pain in the thigh has been constant for several months this time.

Examination: All spinal motions limited. Moderate list to right. Left thigh shows atrophy of one inch; left calf one-half inch. Rectal examination negative. Wassermann negative. X-ray showed large fish-tailed process on the left side of the fifth lumbar vertebra. There was also some osteoarthritic change present.

November 10, 1921. Operation: transversectomy, left fifth lumbar. The process was found in contact with the ilium with a fibrous cord extending from the tip of the process to the ilium.

The patient had very little postoperative trouble. The sciatic pain had disappeared by the eighth day. He was up and walking with a cane in two weeks. Postoperative x-ray showed complete removal of process. The patient was discharged from the hospital January 19, 1922. The motions of the spine had improved somewhat and he was free from pain. The scoliosis still remained, and the weakness of the left leg remained, causing a limp. He has not been seen since.

CASE 6. R. B. Salesman; age, 40 years.

Complaint: Pain in right buttock, thigh and leg. Duration, eight months. Began in right foot and gradually worked up the leg, localizing in the low back about a month after its first appearance.

He had been in another hospital for two months previous to entering Cook County Hospital. His tonsils had been removed six weeks before. The hip and sacroiliac joint had been manipulated under ether without benefit.

Examination: Slight list of spine to the left. All motions of lumbosacral joint were limited. There was slight atrophy of right thigh and calf. Some weakness of anterior tibial group of muscles. Rectal examination negative. Wassermann negative. X-ray showed slight superposition of transverse process of fifth lumbar vertebra on the sacrum.

February 13, 1922. Operation: transversectomy, right fifth lumbar. Process in contact with sacrum, and heavy fibrous cord present. Following the operation the patient had severe pain in the right leg, which did not disappear entirely for two weeks.

Postoperative x-ray showed complete removal of process. He was placed on exercises and occupational therapy. Discharged March 14, 1922, walking with cane.

He returned April 25 to report that the pains in the back and legs were all gone and that he was working. The list of the spine had disappeared and the motions of the spine were free.

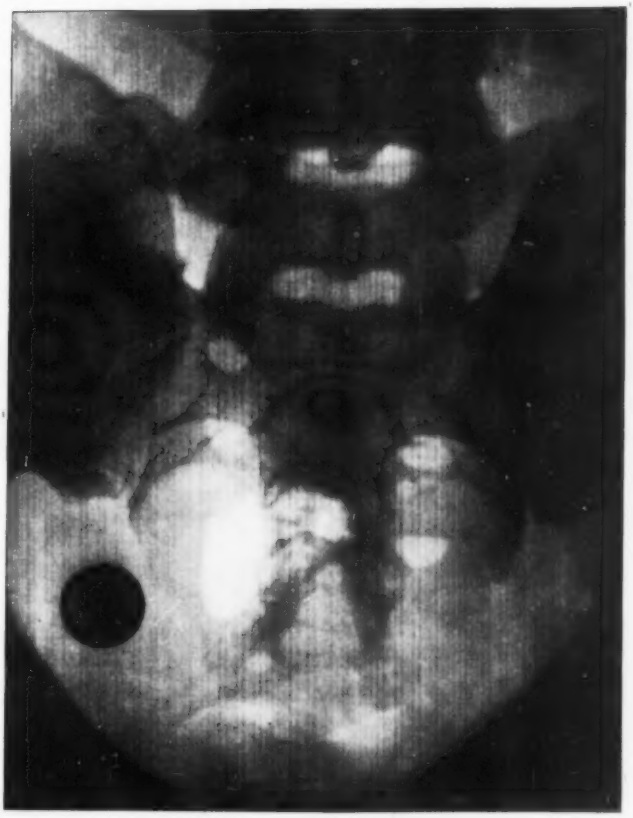
CASE 7. J. F. Teamster; age, 47 years.

Complaint: Pain in lower back, both hips, and left thigh and leg. Duration, three months. Began as low back pain on both sides and was slight for three weeks. Then became severe enough to disable him from working and had been constant ever since. Pain in the left thigh and leg is described as "pulling."

Examination: Moderate list of the spine to the left, tenderness in lower lumbar region and upper part of buttocks on both sides. Muscular twitching of left thigh. Spinal motions all limited. Lumbar curve diminished. Rectal examination negative. Wassermann negative. X-ray showed very large butterfly transverse processes on both sides overlapping the ilium.

March 10, 1922. Operation. The left process was removed. The process was found in contact with the ilium and the usual heavy cord was present. The patient had very little post-operative trouble and the sciatic pain had left by the fifth day. The patient got out of bed on the seventh day. Postoperative x-ray showed removal of process.

Patient left the hospital in three weeks with no symptoms.

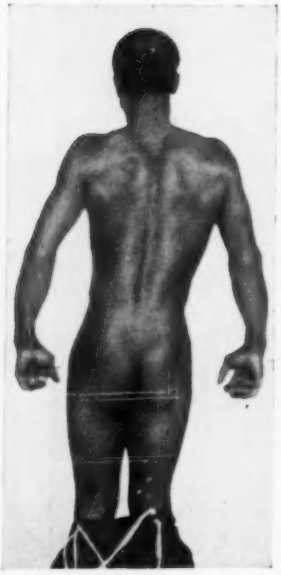


CASE 8.—Sacralization of a sixth lumbar vertebra.

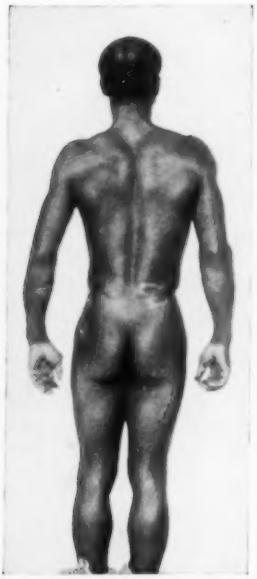
CASE 8. C. J. Negro porter; age, 42 years.

This case presented unusual features. The pain began in the left ankle and outer side of calf and in the left buttock near the cleft of the buttocks. It was so severe that he was unable to walk or move. Gradually became less, but there remained a dull ache with occasional "trickling" sensation down the back of the thigh to the region of the outer malleolus. This had been present about six weeks when patient was first seen.

Examination showed a moderate list of the spine to the right, which could not be voluntarily corrected. Patient could bend to the right well, but any attempt to bend to the left caused sharp pain to start down the left leg to the outer side of the foot and ankle.



CASE 8.
FIG. 1.—Before operation. Showing maximum voluntary correction of scoliosis.



CASE 8.
FIG. 2.—Erect position three weeks after operation.

CASE 8.
FIGS. 3 and 4.—Showing lateral motion of spine three weeks after operation.

The x-ray showed six lumbar vertebrae. The fifth vertebra had small transverse processes resembling those of a normal fourth, but the sixth showed very large transverse processes impinging on the ilium at the sides and the sacrum below. Mauclaire has reported a case with similar findings.

June 3, 1922. Operation. Excision of portion of ilium impinged on by the transverse process. No attempt was made to remove the process in this case. The sciatic pain disappeared completely by the fourth day and this patient got out of bed on the sixth day. In two weeks the list of the spine had disappeared. The motions of the spine are normal in extent now, one month after operation.

While it is much too early to venture an opinion as to the outcome of the case, it has certainly showed very marked improvement.

CASE 9. A. S. Age, 47; laborer.

Complaint: Tenderness and pain in right upper buttock. Duration, six weeks. Eighteen years ago had a severe attack of sciatica for which he was treated by rest in bed and leg extension. This attack lasted several months, but he has had no trouble since until the present pain began. Has had several infected teeth removed and trouble is clearing up.

Examination: Motion limited at lumbosacral junction. Tenderness over right sacroiliac line. Rectal examination negative. X-ray showed complete sacralization of transverse processes of fifth lumbar. The right sacroiliac junction is entirely obliterated and there is a dense area of bone in this region. There is a question as to whether this represents an old healed sacroiliac disease or a new growth. The case is of interest largely on account of the attack of sciatica eighteen years ago and the present findings.

The clinical picture in all these cases is that of irritation of the sciatic nerve, combined usually with some deviation of the spine from the vertical. It does not differ materially from the picture presented by arthritis of the lower lumbar spine associated with sciatic pain except that there is less general rigidity of the spine and more localized limitation at the lumbo-sacral junction. The x-ray is the determining factor in the diagnosis, but one plate is not a safe guide. Several should be taken at varying angles or stereoscopically to determine completely the relations of the process to the sacrum and ilium. Furthermore, in cases with a marked list of the spine, the x-ray may not show the process in contact with the ilium, yet at operation they are found in close contact. The

list of the spine is apparently an attempt to draw the process away from the ilium.

The mechanism of the production of the pain is an open question. The several theories are:

First: That it is produced by pressure of the soft parts, *i.e.*, muscle or ligament, between the transverse process and the ilium.

Second: That it is produced by irritation or arthritis of abnormal bursae or joints.

Third: That it is due to strain of the sacroiliac and lumbosacral joints due to the leverage of the transverse process.

Fourth: That it is due to stretching or pressure on the nerves of the lumbosacral plexus.

As to the first and second theories, in none of the seven cases of this series operated on, was there any muscle interposed between the process and the ilium. Nor was a bursa found in any case. In only one case, No. 8, was there anything resembling a joint and there was no gross evidence of arthritis in that.

As to strain of the joints in the lumbosacral region, it is mechanically possible. A transverse process impinging on the ilium would form the short arm of the lever and the spine above the fifth lumbar vertebra the long arm. In spite of the fact that the long arm is somewhat flexible, powerful leverage would be exerted both on the sacroiliac and lumbosacral joints.

So far as pressure on the nerve is concerned, the fifth lumbar nerve, which would be the one affected, passes from the vertebral column at the base and in front of the transverse process, where it would seem to be well out of harm's way so far as pressure by this enlarged process is concerned.

It is possible that a combination of the third and fourth theories will best account for the trouble; that is, that the leverage of the process causes a slight shifting of the entire fifth lumbar vertebra, enough to produce pressure on the nerve at its exit. The symptoms are those of nerve irritation and not those of complete nerve block, so that a very slight shift would be enough to account for it.

The fibrous cord found extending from the tip of the process to the face of the ilium may be of importance in this connection. Fassett also noted this cord in two out of three of his cases. It may be a factor in dragging on the vertebra as leverage is exerted.

The question as to why the trouble comes on usually so late in life is a difficult one to answer. The abnormal processes themselves are a

developmental peculiarity. They may give rise to a potential weakness which some strain transforms into an active pathological process. Bertolotti believes the onset of symptoms has a direct relation to the completion of ossification of the ilia and the fifth lumbar vertebra which occurs between 25 and 30 years. The first case reported by Adams was in a girl 16 years old, and Richards has reported one 13 years of age.

*Treatment.*—This has run the gamut from radical operation to x-ray treatment, and all forms have successes reported. These successes have done much to confuse the subject. Case No. 3 is the fly in the ointment in the series reported here. Certainly there must have been another element than the sacralization in this case, if any reliance can be placed in the therapeutic test.

As to the results of the radical operative treatment, opinion differs widely. Richards made the statement that no case has been completely cured by operative measures. However, Adams, Fassett, Blanchard and Parker, Magnuson and Shackelton have all reported cases in which relief had been obtained following operative removal of the process.

The operation in the series reported in this paper was amputation of the process in six of the cases. The technic used was somewhat different from that usually described.

The skin incision, about six inches long, was over the posterior portion of the crest of the ilium, which was exposed. The lumbar and gluteal muscles were then stripped subperiosteally from this portion of the crest. A segment of bone, about two inches long and one inch wide, was cut from the ilium and removed. This was done with a double purpose. It made an easier approach to the process and it removed the portion of the ilium impinged upon by the process. The process was then freed from the fibrous cord usually found and removed with an osteotome. Closure was made by suturing the periosteal edges with the muscles and the usual skin closure.

In the last case operated upon, No. 8, the crescent of bone was removed and the process left intact. The case is too recent—one month—to say what the final result will be, but so far it has run the same course as the others; that is, the pains have been relieved and the motion of the spine improved. If the relief is permanent this is certainly a much simpler and easier operation.

None of the cases were put in plaster or braces, and they were gotten out of bed in 10 to 14 days. Back-bending exercises were begun as soon as they could be done with comfort.

*Results.*—In five of the seven cases the relief from the sciatic pain was rather striking. It disappeared by the fourth or fifth day. In the other two it was slower, lasting 10 to 14 days after the operation.

The scoliosis was slower in disappearing and usually persisted two or three months. In two of the cases, postoperative x-ray showed that the process was not completely removed, yet the symptoms were relieved. In these cases the removal of the portion of the ilium was probably the effective part of the operation.

These cases are all too recent to decide as to the complete permanency of the results, but they are encouraging. However, equally encouraging results have been reported by manipulation under ether and other treatment.

Cases such as No. 3 and No. 9, where there was evidently another factor than the sacralization in producing the sciatic pain, are a sufficient warning against over-enthusiasm.

The question cannot be considered closed as yet.

# THE OPERATIVE TREATMENT OF HALLUX VALGUS.

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HALLUX VALGUS, of the common type, is in most cases not a simple deformity, but only one factor in a general distortion of the forefoot. Hence, although the majority of patients presenting this affection merely seek relief from pain, no method of treatment can be considered sufficient which does not have for its final object the correction of this general distortion and the restoration of foot function. This means, therefore, not only that the operative procedure chosen should be, if possible, one which restores the normal anatomic relations, but also, as is so frequently the case in the treatment of deformities, that the operation itself is only one step in treatment.

In the treatment of hallux valgus the essential pathological changes to be considered are the following:

*Gross Changes.*—The great toe is deflected toward the outer border of the foot and with this is associated a corresponding degree of subluxation of the phalanx on the metatarsal head. The forefoot is spread, the space between the first and the second metatarsal bones increased, and the first metatarsal is rotated on its long axis, the inferior surface of the head turning inward. The four smaller toes are also deflected outward and are usually dorsi-flexed. A prominence is present on the inner side of the great toe-joint. Leaving the enlargement due to actual bunion out of consideration, this is formed partly by the inner portion of the head which has been uncovered through the subluxation, partly by the projection of the prominent inner edge of the inferior portion of the head brought about through the rotation, and usually only to a lesser degree by any actual bone hypertrophy.

*Joint Changes.*—The internal (mesial) lateral ligament and the entire inner portion of the capsule are stretched, while the external lateral ligament and the external portion of the capsule are correspondingly shortened. Except when joint disease has existed, the articular cartilages present little, if any, gross change.

*Changes in Muscle Balance.*—The extensor and flexor tendons, together with the sesamoid bones, are displaced to the outer side of the joint, and hence through their bowstring action tend to perpetuate the deformity. That there should be shortening of any appreciable im-

portance in muscles of such length as the long flexor and extensor seems unlikely. The adductors, whose action tends naturally to increase the deformity, have undergone sufficient structural adaptation to the deformed position to prevent the normal degree of abduction. This is no doubt less pronounced in the case of the obliquus hallucis on account of the direction of its fibers and the consequent compensating effect of the spreading of the forefoot. The abductor hallucis, which normally abducts and flexes the great toe and which is the only muscle available to oppose the deforming tendency of all the others, is displaced toward the plantar surface of the joint and hence has lost its abducting power.

To enter into a detailed consideration of the advantages and disadvantages of the various procedures which have been proposed for the correction of this affection is unnecessary. These are well known to those doing this type of work. Let it suffice merely to say that operation should have for its object the correction of pathology and that to mutilate a joint in order to overcome joint deformity seems most unscientific. Viewing the pathological changes from the operative standpoint, it seems evident that it is necessary to remove only the actually hypertrophied bone, and that the real obstacle to the correction of the distortion of the toe lies in the structural shortening of the tissues on the outer side of the joint, while the difficulties of retention are found chiefly in the loss of muscle balance and to a lesser extent in the structural lengthening of the inner capsule. These are the particular points, it seems to me, which have not been given sufficient consideration in previous operative procedures. The following method of operation is proposed, therefore, because (1) it aims at the correction of the various pathological changes and so restores the normal anatomical relations, (2) it leaves the articular surfaces unimpaired and hence gives rise to no risk of limitation of toe flexion and extension, and (3) it interferes in no way with the subsequent performance of any other procedure in the rare event of the recurrence of the deformity. Most of the details of the operation have been long in use and hence no originality is claimed, except possibly for the method of treating the internal and the external portions of the capsule and the definite attempt to restore muscle balance.

*The Operative Technic.*—a. The usual curved incision with the convexity downward is made.

b. After the fibrous capsule has been exposed by dissection of the skin flap and the bursa removed, if indicated, a Y-shaped incision is made through it (See Fig. 1A) so as to form three flaps, a distal flap whose base is attached to the phalanx, and dorsal and plantar flaps; anteriorly the incision should be carried well forward upon the phalanx,

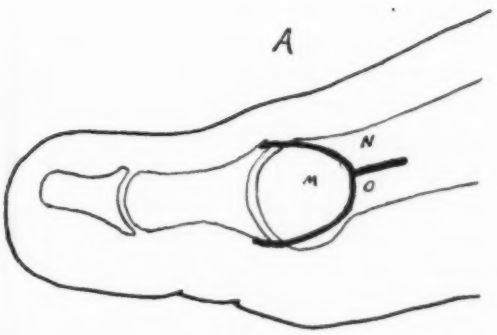
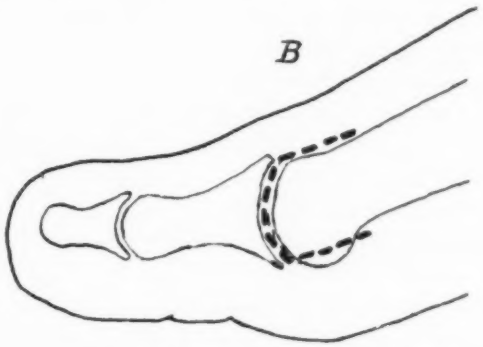
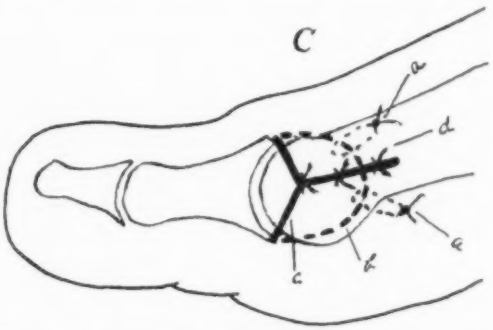



FIG. 1.

A. Position of Y-shaped incision through the internal portion of the capsule shown by the heavy line. m=distal flap. n=dorsal flap. o=plantar flap.




B. Position of incision through the external portion of the capsule shown by the interrupted line.




C. Method of suture of the distal, dorsal and plantar flaps. a=mattress suture. b=distal flap, drawn back beneath the dorsal and the plantar flaps, shown by interrupted line. c=position of dorsal and plantar flaps, when sutured, shown by heavy line. d=interrupted sutures through dorsal and plantar flaps.

but it is not wise to go too far posteriorly, as it is necessary that the posterior attachment of the distal and plantar flaps to the metatarsal be unimpaired. The distal flap, about one-half to five-eighths of an inch long, and as broad at its base as the side of the phalanx, is carefully freed of all areolar tissue on both its outer and its inner surfaces; it is to serve for the reconstruction of the internal lateral ligament. The dorsal and the plantar flaps are dissected back so as to sufficiently expose the metatarsal head and inferiorly the tendon of the abductor hallucis.

c. The great toe being then adducted, a flat chisel is placed against the anterior edge of the inner portion of the head and a thin layer of the cortex, together with the periosteum and any exostoses that may be present, is removed, thus leaving a smooth surface of denuded bone. None of the articular surface is removed, only a little of the cartilage which extends over the side of the head being cut away; the edge must not, however, be left sharp, but should be rounded. Care must be taken not to leave any periosteal shreds.

d. The next step is the formation of an external capsular flap with its base attached posteriorly to the metatarsal (See Fig. 1B). The distal and the dorsal and plantar flaps are now retracted and the great toe held in slight dorsal flexion with traction to put the capsule under tension. A strong tenotome is then inserted between the superior portion of the capsule and the head, and a superior longitudinal incision made from the top of the phalanx backward to the posterior limits of the capsule. Then with the toe slightly plantar flexed, an inferior longitudinal incision, as close to the flexor tendon as possible, is made in a similar manner. Finally, with the toe adducted and under sufficient traction to separate the joint surfaces, a vertical incision is made through the capsule close to the base of the phalanx uniting the two longitudinal incisions and thus completing the formation of the flap. In making this vertical incision, the attachment of the tendons of the adductor and obliquus hallucis, which is toward the plantar surface of the base, is divided. If these incisions have been properly made, all resistance will be overcome and it will then be possible to correct the subluxation of the phalanx on the metatarsal head, to bring the toe into extreme overcorrection (45° abduction), and to displace the flexor and extensor tendons, together with the sesamoid bones, to the inner side of the joint.

e. The subluxation having first been corrected, the great toe is then held in extreme overcorrection (45° abduction), and the distal flap, which is to form the new internal lateral ligament, is sutured in position with two mattress sutures of chromic catgut (see Fig. 1C). The first suture is passed through the dorsal flap well back toward its posterior

end and through the upper corner of the distal flap, while the second suture is similarly placed between the posterior end of the plantar flap and the lower corner of the distal flap; when the two sutures are tied, the distal flap is drawn strongly backward beneath the dorsal and plantar flaps, thus holding the toes firmly in the overcorrected position, and its roughened under surface is spread out over the denuded bone area on the inner portion of the head. The dorsal and plantar flaps are then drawn strongly inward and sutured with interrupted sutures of chromic catgut as far forward as possible, overlapping the distal flap. In passing these sutures through the plantar flap, the abductor tendon should be included. This brings the flexor and extensor tendons, together with the sesamoids, toward the inner side of the joint and pulls the abductor hallucis up into its normal position, thus completing the restoration of the muscle balance.

f. The skin is closed with waxed silk, a cotton compression dressing (English method) is applied to prevent bleeding and swelling, and an aluminum splint added to maintain extreme abduction.

*Subsequent Treatment.*—Too great emphasis cannot be laid on the necessity of following a consistent plan of after-treatment until normal foot function is reëstablished. This is sufficient excuse for outlining briefly the measures indicated even although most of them have already been covered in the articles of others. Attention to the remaining deformity in the forefoot must be begun as early as possible. In a few days, after soreness has disappeared, a bias flannel bandage is substituted for the cotton dressing, the splint being retained. This bandage is applied so as to cover the entire foot except the great toe, the turns being made first from within outward over the dorsum so as to overcome the spreading of the anterior arch, and then from behind the heel obliquely forward over the small toes so as to force them downward and inward; it should be re-applied daily, special attention being paid to securing and maintaining overcorrection of the deformity of the four smaller toes, and should be worn constantly until the foot is ready for the shoe. The skin sutures are removed in five to seven days and a collodion dressing applied. Walking on the outer borders of the feet is begun in a week. Not only does the use of the foot in this position strengthen the arches, but also, since all the toes are held in the overcorrected position by the dressing, it is a valuable aid in the restoration of muscle balance.

In from three to four weeks, depending on the severity of the case and the manner in which overcorrection of the great toe is maintained, the foot may be made ready for the new shoe. The splint is removed and adhesive strapping used to relieve the new ligament of part of the

strain to which it is to be subjected. For this strapping four to six pieces of adhesive plaster, a half inch wide and about eight inches long, are required. With the great toe held in the overcorrected position, the first strip is placed against its outer side near the tip of the toe, carried backward and inward over the top of the toe to the center of the great toe-joint and then obliquely backward upon the sole, being drawn tight while the skin is pulled strongly forward; the second strip starts near the same point but passes under the toe to the center of the great toe joint and then obliquely backward over the dorsum of the foot; the remaining strips are applied in a similar manner, overlapping the first two. The correction of the spreading of the anterior arch which has been secured by the bandaging is retained by the use of an anterior leather lacing. In severe cases it may be even advisable to supplement this for a time with adhesive strapping, since the normal position of the great toe cannot be long maintained if the forefoot be allowed to spread. In some cases, of course, some other form of anterior support may be required. A stocking with a digit for the great toe (Japanese sock), which is made by altering an ordinary stocking, is used during the early weeks. Since the foot is usually slightly larger than normal and so, since it is not wise to have the new shoe fitted at once, an old shoe of fair shape may be taken and the inner half of the toe cut out as far back as, but no farther than, the center of the great toe-joint; this permits the great toe to retain its abducted position. In a few days swelling is sufficiently reduced to permit the new shoe of the in-flare type to be fitted.

The bandage, and even the splint if thought necessary, should be reapplied for the first few nights. The adhesive strapping should be gotten rid of as soon as possible to permit the use of hot and cold douching. There seems to be no need of paying any attention to toe flexion and extension, but passive abduction to prevent recontraction of the external portion of the capsule should be practised by the patient for a considerable period.

A normal, or approximately normal, foot form having been secured, attention must then be directed to the restoration of foot function, the chief safeguard against relapse and the final object of treatment. Only when the proper use of the foot in both standing and walking becomes instinctive can the patient be discharged with safety, and this result cannot be secured by the performance of a few exercises and by taking a few steps in the proper manner once or twice a day. A short course of intensive training is required. With individual attention by the surgeon and reasonable application on the part of the patient, anyone who does

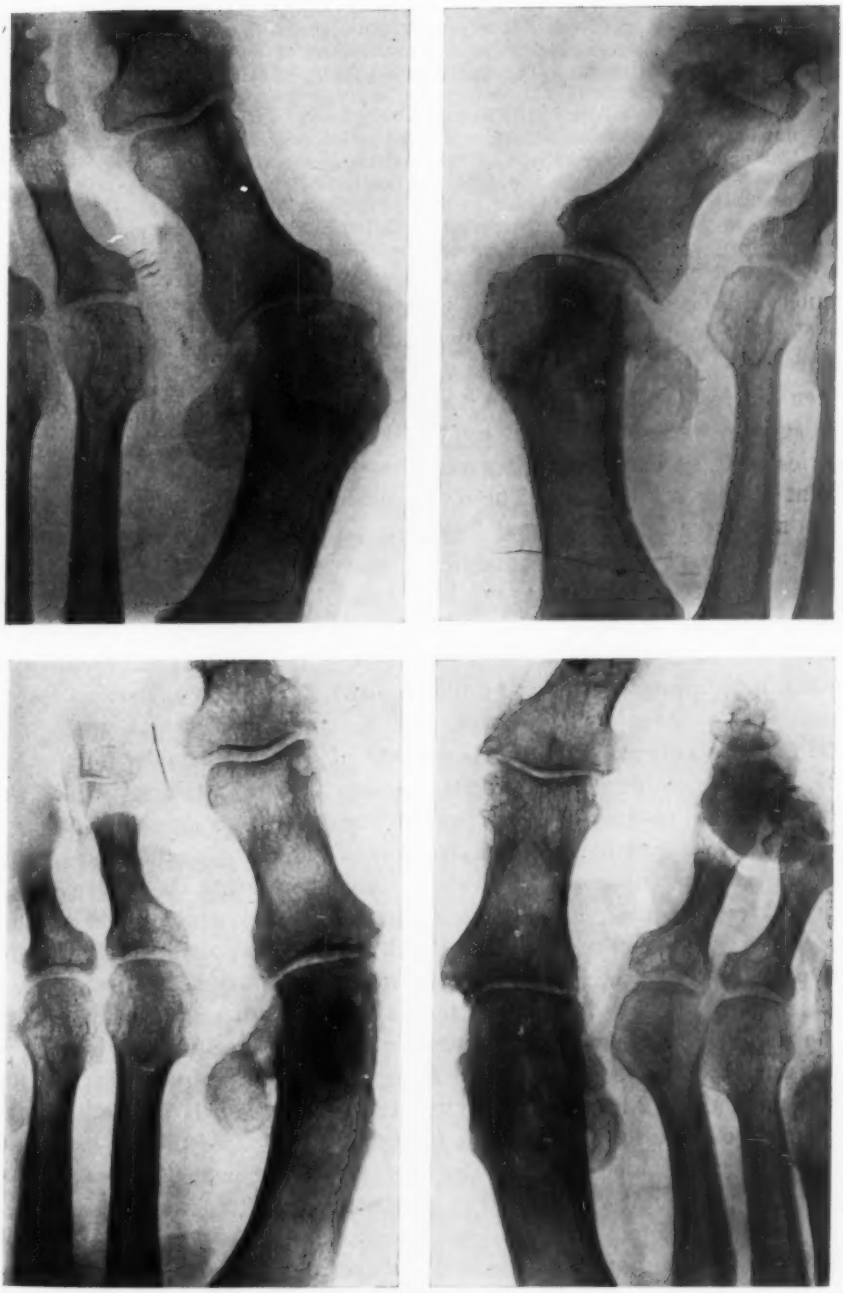


FIG. 2.—Radiograms of R. F. N. before operation (above) on January 27, 1921, and after operation (below) on January 5, 1923. This man, a ward patient,

did not report after operation as directed. When seen two years later, the left foot presented an excellent clinical result, while the right showed a relapse of ten or fifteen degrees with some spreading of the forefoot. Correction of this spreading by an anterior lacing of leather gave a very satisfactory clinical result. The radiogram shows, however, that the correction of all the elements of the deformity has not been attained, the sesamoids of the right foot being still displaced outward, while those on the left are not exactly in position. This explains the relapse and makes the final result less certain. This was one of the earliest cases and only the vertical incision was made through the external portion of the capsule, while it is now recognized that the addition of the longitudinal incisions, thus forming a flap, is required to secure proper mobilization of the sesamoids.

not present organic foot change can readily acquire a sufficiently normal function to meet the demands of everyday life.

*Clinical Report.*—The first operation by this method was performed November 27, 1920. Since then 49 such operations on 31 patients have been performed in the Department of Orthopaedic Surgery of the Allegheny General Hospital by Dr. Paul B. Steele and myself. The series includes cases of all degrees of severity but none in which actual joint disease has existed. The oldest patient was 66 years of age. One was a reoperation for relapse following partial resection of the head of the metatarsal in other hands; all others were primary operations. While, unfortunately, it has not been possible to secure a final report on every case at this time, all have been followed from several months to two years after operation. A partial relapse occurred in one toe, in two cases, both bilateral, the first following the wearing of a too short shoe soon after shoe wearing was begun, and the second owing to failure to correct the displacement of the sesamoids (see Fig. 2). In no other case is relapse known to have taken place. In two cases a moderate hallux varus occurred, persisting in one for several weeks and in the other for several months, thus demonstrating the positive retentive action of the method of treating the internal portion of the capsule. All the other cases presented straight and flexible great toes when last seen. Those which it has been possible to follow for the longest periods, six months to two years, continue to present toes which may be justly classed as normal. Although my experience with the various other methods of operation for hallux valgus has been very satisfactory, I have no hesitation in saying that the results obtained by this method have been decidedly better both as regards form and function. The operation is applicable to any case, whatever the age or degree of severity, in which the articular surfaces do not present gross change, but it is particularly indicated in younger subjects, in whom a complete restoration of function should be sought. It should not be performed, however, unless both surgeon and patient are willling to continue the after-treatment until the accompanying deformity of the forefoot has been overcome.

# AN OPERATION FOR THE RELIEF OF FLEXION-CONTRACTURE IN THE FOREARM.*

BY C. MAX PAGE, M.S., F.R.C.S., LONDON.

FLEXION-CONTRACTURE in the forearm results from several distinct conditions. The outlook as regards the ultimate function of the hand affected varies considerably in the different types. In civil practice the commonest cause is, perhaps, ischemic paralysis; a flexion-contracture also occurs in association with monoplegia and paraplegias. Another type which has become relatively common since the war is associated with section of the ulnar or median nerves; in these latter conditions the contraction of the flexor tendons is superimposed upon the deformity produced by paralysis of the lumbrical muscles.

The first step directed to the restoration of the function of the hand in all instances of the condition is the full correction of the contracture: this can usually be effected by properly applied methods of splintage. There remain, however, a certain number of cases in which, either from lack of early treatment or on account of an obstinate tendency to recurrence, this method, however patiently carried out, fails. Under such circumstances, some operative procedure becomes justifiable. The methods which have hitherto been put forward are, as far as I know, two: namely, either the shortening of both bones of the forearm, or the elongation of the individual tendons which have become shortened. Neither procedure is free from drawbacks, nor are the results, so far as they have come under my observation, very satisfactory.

As an alternative to these operations I have carried out in six cases a muscle-sliding operation which appears to me to offer a better hope of success. The immediate results are certainly very good. I have, as yet, no evidence as to the late outcome. The causes of the contracture in these six cases were as follows:

| | |
|---|---|
| Ulnar nerve palsy | 3 |
| Ischemic paralysis | 1 |
| Monoplegia | 1 |
| Hemiplegia | 1 |

The technic of the operation is as follows: A skin incision is made extending from three inches above the inner condyle of the humerus to about the junction of the middle and lower third of the forearm. The cut commences above on the line of the ulnar nerve and passes down the

*Read before the British Orthopaedic Association, October 20, 1922.

back of the forearm just to the ulnar side of the subcutaneous border of that bone. This incision, with suitable undercutting, affords a full view of the operation area. The ulnar nerve is first isolated at the level of the elbow and transposed to the front of the joint, where it will be out of harm's way during the ensuing procedure. The attachments of the whole flexor group of the forearm are next systematically detached from their origin, the supra-condylar ridge is cleared and the common tendon of origin of the flexors is cut close to the internal condyle and stripped away from the lateral ligament (the elbow joint is usually opened at this stage). The aponeurosis on the ulnar side of the subcutaneous aspect of the ulna is then cut through in its whole length close to the bone. The muscle mass so loosened is raised from the surface of the bone with a raspatory, any definite tendinous origins below the coronoid process of the ulna are divided with the knife, the insertion of the brachialis anticus being fully exposed. If the flexor longus pollicis is contracted the process of muscle-stripping is carried across the interosseous membrane so that the attachment of the thumb flexor to the front of the radius can also be raised.

Lastly, the bicipital fascia is cut through if it appears to offer any opposition to the descent of the muscle group. If care is taken to keep close to the bone during these procedures no important vessels are divided and no damage can be done to any nerve except the anterior interosseous and the terminal part of the internal cutaneous.

The separation of the muscles and of any tight fascia is carried out to such an extent that nearly full correction of the contracture, apart from phalangeal joint deformities, is possible at once. The whole muscle group will be made to descend an *inch* or more from its origin. It may be noted that the correction of the contracture usually appears to be more complete a week or two after operation.

After suture of the skin the hand is put up in the corrected position on a metal splint; this is replaced by a properly fitting plaster mould in a few days' time.

Voluntary control of the mobilized muscles is lost or becomes very weak for a few days after operation and is then gradually recovered. The plaster mould is worn for most of the day during the period of muscle re-education so as to enable the extensor muscles to recover their tone and become effective opponents.

I need not emphasize the point that this procedure is but the first stage towards the restoration of the use of the hand. Careful splintage and the usual physiotherapeutic measures must be employed in order to complete the cure.

# CONCERNING THE DIAGNOSIS OF LESIONS OF THE LATERAL PROCESS OF THE FIFTH LUMBAR VERTEBRA AND OF ITS REMOVAL.

BY J. TORRANCE RUGH, M.D., PHILADELPHIA.

SINCE Goldthwait first called attention to the importance of congenital anomalies in the lower lumbar portion of the spine as factors in back and leg pains, orthopaedic surgeons have been watching and studying intimately this portion of the body, in order to determine more accurately the actual relation between anomalies and obscure symptoms. Among these anomalies, changes in the lateral process of the fifth lumbar vertebra have received a great deal of attention, and many different forms and conditions have been described. It is not the purpose of the writer to take up these malformations in detail, but rather to call attention to a fairly common error in the diagnosis of pressure, overlapping, or a distinct articulation between the end of the lateral process of the fifth lumbar and the crest of the ilium or the upper part of the sacrum. One frequently sees x-ray pictures of this part, which appear to show contact between the lateral process and the neighboring parts. These are made in a direct antero-posterior plane and if the process is a little longer than normal, it will appear to be in contact with the ilium, while in reality, it lies anterior to this part, and may be separated by from one-quarter to one-half an inch. If stereoscopic plates are made, the relations of the two portions will be evident, but as the pictures are ordinarily taken, there is a large margin of error possible. A study of this part by direct plates other than stereoscopic, can be made only by taking them in five different directions. These are:

1. Antero-posteriorly,
2. Obliquely from above downward.
3. Obliquely from below upward,
4. Obliquely from the right side,
5. Obliquely from the left side.

A study of plates thus made will enable one to determine accurately the relation between the lateral process and the crest of the ilium or the top of the sacrum, and a diagnosis of pressure or contact between these two parts should not be made until such a study has been completed.

Another point of interest and value gained from the x-ray plate and which has a direct bearing upon the operative procedure, is the shape of the pelvis. The x-ray plates will show clearly the type of pelvis belonging to the individual and one may know quite accurately before operation, whether much or little difficulty will be encountered in the removal of the process or in the relief of pressure. If a line be drawn across the back between the iliac crests, the lateral processes of the fifth lumbar vertebra will be found slightly below it and the best approach to them is along the posterior curve of the crest of the ilium, rather than next to the spinous processes. If the patient possesses the *male* type of pelvis, in which the ascending curve is almost perpendicular and parallel to the spinous processes, the space between the posterior border of the ilium and the spinous process will be found very narrow, while if the pelvis is of the *female* type, the ascending curve rapidly receding from the spine and flaring more posteriorly, there will be found more room for operative procedure. The removal of the outer end of the process in the case where the ilium runs high and close to the spine, proves a difficult operation and it can be accomplished only through the sense of touch in the bottom of a wound from 2 to 2½ inches in depth. A number of operators have injured the communicating branch between the last lumbar and the first sacral plexus of nerves, where it runs directly in front of the lateral process, and have caused a paralysis in the leg. When one is forced to work by the sense of touch in the depths of a wound, the danger of injuring this nerve and causing paralysis of some of the structures in the lower extremities is an actual one. There are two means of avoiding this, however, the first of which is to be content with the removal of the end of the entire process or of even the outer half. This will be found entirely feasible and very satisfactory as to results, though, of course, must usually be done by the sense of touch. The other method of avoiding the nerve is by the removal of a piece of bone from the border of the ilium opposite the lateral process, thus relieving the pressure between the two parts. This is not difficult and likewise proves satisfactory in its results. If one is familiar with the osteotome and mallet, the separation of the lateral process is fairly easy, but otherwise its removal must be accomplished by forceps and curette, and care must be taken to push the periosteum away from the anterior surface of the process before attempting its extraction.

# FRACTURE OF THE NECK OF THE FEMUR WITHOUT SHORTENING.

BY HENRY LING TAYLOR, M.D., NEW YORK, N. Y.

In the clinic of the Hospital for the Ruptured and Crippled, New York, and presumably in most large bone clinics, it is not very uncommon for patients with recent fractures of the neck of the femur, who show no shortening or but a trivial one, to apply for treatment. A considerable number of these patients are able to walk at once with little or no assistance, and in nearly all of them the true diagnosis has not been made. They complain of pain about the hip, groin, or thigh, and of varying amounts of disability. There is usually considerable lameness and there may be more or less limitation of motion; there is usually some persistent eversion, but many of the classic symptoms of fracture of the neck of the femur are absent.

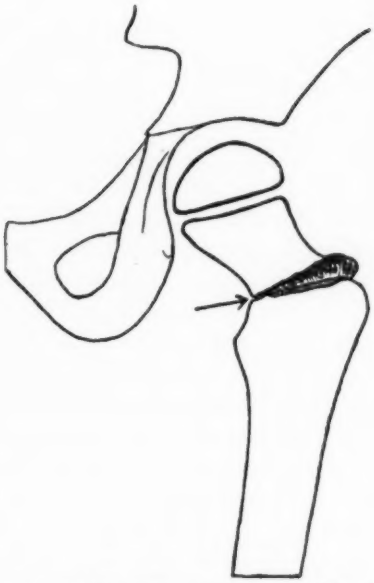
These cases are of several types:

1. Fractures of the neck of the femur in young children.*
2. Epiphyseal fractures in adolescents.
3. Various types of impacted fractures, one of which is the type with vertical displacement of the shaft downward with a coxa valga deformity, instead of upward.
4. There are, besides, various minor fractures and injuries in the neighborhood of the hip, causing pain and disability, which may be mistaken for fractures of the neck, where an x-ray plate is not taken. Most of them show no shortening.

1. It is not generally known that fractures of the neck of the femur are not very rare in young children of five or six or even younger. I am not now speaking of epiphyseal separations in adolescents, of which mention will be made further on, but of true fractures of the neck, which nearly always take place in young children at or near the base of the neck, and which I have called hinge fractures of the neck, since the periosteum on the lower side of the neck often holds, and if there is separation, it occurs as a V-shaped opening, base up, from angular depression of the neck, or rather forcing up of the shaft; there is seldom displacement *en bloc*. If these children are brought for treatment with-

*See paper by the writer in N. Y. State Journal of Medicine, November, 1917.

I. Boy; age, 8 years. No treatment. No shortening. Five months after fall.



II. Girl; age, 5 years. Right hip. Legs equal. One week after injury.

III. Girl; age, 4 years. Right hinge fracture; one-quarter inch shortening.

IV. Boy; age, 4 years. Left hinge fracture; one-quarter inch shortening.

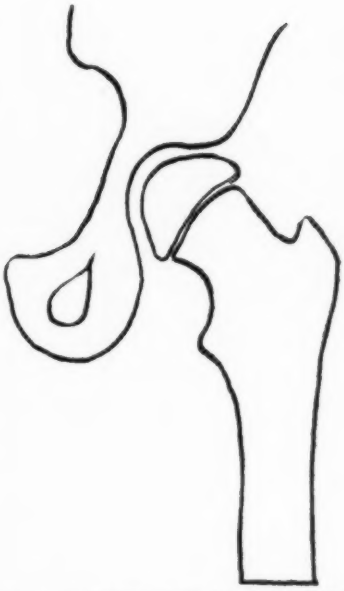
V. Boy; age, 3 years. Hinge fracture; two weeks after fall.

VI. Boy; age, 6 years. Fracture at base; one week after injury.

VII. Girl; age, 4 years. Right hinge fracture, eight days after fall; one-quarter inch shortening.

VIII. Boy; age, 6 years. Left hip; four weeks after injury.

IX. a. June 22, 1921. Boy; age, 13 years. Right epiphysis slipping. No injury known.



IX. b. Same case, Nov. 22, 1921.

X. a. Girl; age, 13 years. Fracture of left epiphysis. Dec. 6, 1916.

X. b. Same patient, Feb. 1, 1917.

XI. Woman; age, 40 years. Impacted fracture, upward displacement. One year after fall.

out being allowed to walk, there is often no displacement, and consequently no shortening, but if an angular displacement has been allowed to occur, there may be caused a coxa vara and shortening. These cases are particularly appropriate for the abduction treatment.

2. Epiphyseal fracture in adolescents from 12 to 16 is not uncommon and is of two types, traumatic and spontaneous. The first occurs suddenly after an injury, or it may be after repeated injuries. If seen early, it may be replaced by forced abduction under strong traction. The second type is a spontaneous sliding of the epiphysis, which may take place gradually and without a fall or other injury in rapidly growing youths; apparently many of them have an endocrine disturbance, and they are prone to flat feet, knock knees, round back, coxa vara and other static deformities. The epiphyseal fracture may be bilateral. The disability at first may be slight, and the shortening slight or absent in either type of case.

3. Impacted fractures. In some of these, the impaction takes place at the expense of the superior and posterior surfaces of the neck, with limitation of adduction and internal rotation and a tendency to coxa valga.

Impacted fracture right femoral neck. Woman, age 40; seen March, 1915.

Thirteen months before, slipped and fell on street, with right leg doubled under her. Intense pain in hip, but no swelling, mark or bruise. In bed a week; began to go out in three weeks. Consulted several physicians, but no diagnosis was ever given. Now walks with a cane and marked limp; severe pain when walking.

Examination shows fixed eversion, 60° antero-posterior motion; rotation and lateral motion much limited. There is one-quarter inch of shortening; patient cannot lift foot from table when lying.

Roentgen plate shows fracture, middle of neck, apparently impacted; distal fragment rotated outward; tendency to coxa valga.

There are other cases of impaction where the fracture of the base of the femoral neck sometimes includes the adjacent trochanter in such a manner that there is little tendency to spontaneous displacement, though the fragments may be rather easily separated, and walking should be prohibited. I propose for these fractures the name of locked fractures at the base of the femoral neck. If there is no displacement there is, of course, no shortening. Enough has been said to show that fracture of the femoral neck cannot be excluded from the persistence of the ability to walk and the absence of shortening.

Besides the conditions above described, there occur in adults trochanteric fractures—evulsions of the lesser trochanter; cracks or incomplete fractures of the femoral neck; evulsion of a button of bone from the trochanteric fossa; all causing pain and disability in the vicinity of the hip.

Last summer, I saw a lady of 79, of frail physique, who made a misstep and fell heavily on the right buttock; she could walk a few steps, but had pain below the groin. The x-ray revealed a complete fracture at the junction of the pubes and ischium without displacement. She made a good recovery under rest in bed. I owe the privilege of seeing this case and her plates to her physician, Dr. Dreisbach of Dansville, N. Y. Dr. Dreisbach also showed the plates of a man in the twenties who showed an identical lesion, the result of being pinched between car buffers.

# OBTURATOR DISLOCATIONS.*

BY JAMES T. WATKINS, M.D., SAN FRANCISCO.

SINCE it is probable the reading of my paper cannot be finished in the time allotted me, I shall, for the sake of the discussion, summarize it at once.

In this paper, which is based upon dissections, the reports of findings in 17 and my own findings in one obturator dislocation, I shall attempt to show that in old obturator dislocations—

1—The hindrance to reposition always present is (a) the constriction about the femoral neck caused by the rent through which the head emerged from the capsule; (b) the hindrance caused by the adventitious capsule which has developed about the head in its new location, and (c) the shrinkage which has taken place in the tense, inelastic fascia lata, the muscles which insert into it, and the gluteus medius.

2—I shall point out that while the pelvi-trochanteric muscles are *never* injured in an obturator dislocation, the act of transforming the latter into the iliac type inevitably produces rupture of the quadratus femoris, and usually of other muscles of this group as well, and may cause irreparable damage to the sciatic nerve. My conclusion is, therefore, that this manual transformation should *never* be attempted.

If you can't get the head back otherwise, you had better do a frank excision, and let it go at that.

3—I shall report a case of nearly three months' duration where, by means of a five-inch longitudinal incision beginning just internal to and below the anterior superior iliac spine and paralleling the inner border of the sartorius, I was able to open the capsule in its upper part, inspect the socket and, proceeding from within outward, to cut the restricting bands already referred to. Then, by carrying a transverse incision three or four inches outward from the lower end of the first incision, I was able to divide the fascia lata transversely. When these maneuvers had been carried out, the reduction of the dislocation all but made itself.

*Read at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

FIG. I.—Before operation.

FIG. II.—Before operation.

FIG. III.—Before operation.

FIG. IV.—Before operation.

4—I shall suggest immobilization in flexion and adduction a few days after operation, to be followed by full extension, and then back again to full flexion (just as one does with excisions of the wrist or elbow) In this way I should hope to avoid the ankylosis which is the most common result of open reductions, and which I think to be due to periarticular trauma—myositis ossificans.

In reviewing the literature for this paper, records of 81 old dislocations were found. Some had been reported exactly and in detail, others very sketchily. The material was obtained from the Lane Library, which is said to be the duplicate of the library of the New York Academy of Medicine. However, while the review was fairly broad, it was not exhaustive. No modern French references were found, nor were the writings of the Italians, who are said to speak highly of the work of Fiorani. It is regretted that a description of his method could not be obtained.

To the 81 old dislocations referred to must be added four which have been observed by the writer. Of the 81 luxations, 17 were of the obturator variety. Of the writer's four, one was an obturator luxation.

In attacking the 81 dislocations, six different incisions were employed. They will be analyzed later. Operators used identical incisions with either iliac or obturator dislocations. To these six incisions must be added a seventh used by the writer.

A majority of the obturator dislocations were transformed manually into iliac dislocations, and then operated upon as iliac dislocations. For a very large majority of all dislocations the posterior incision from the trochanter to the posterior superior iliac spine (Langenbeck), posterior inferior spine (Dollinger), was employed.

In attempting to solve the problem of the 18 obturator dislocations, operators were constrained to do six resections. In one case an osteotomy was performed. Twice reduction was accomplished only after the inner wall of the socket had been cut away. Of the 9 which were reduced, one child recovered practically complete function. Two adults recovered partial motion. The remaining 8 became ankylosed. There were three deaths. A majority of the repositions occurred after complete muscular denudation (*Skeletierung*) of the upper end of the femur.

If the pelvis be sawn across in such a way that the section is made through pubis, iliac bones, and sacrum, it will present roughly the appearance of a quadrilateral compressed a little from before backward, with the weight-bearing portions of the hip sockets placed at either lateral angle.

FIG. V.—After operation.

FIG. VI.—After operation.

FIG. VII.—After operation.

When the pelvis is observed as it appears in the normally erect individual, that is, with the sacral promontory directly above the symphysis pubis, it is noted that the planes in which the sides of this quadrilateral lie take a direction downward and inward and upward and backward, meeting each other at approximately right angles in a line drawn from the anterior superior spine to the back of the ischial tuberosity. It is further noted that the socket is deepest and strongest in its upper part where it partially covers the spherical femoral head, and that the bony walls of the socket fade away to nothing as they approach its most dependent portion.

Traumatic dislocations of the femoral head uncomplicated by fracture must then primarily follow two types,—downward and inward or backward and upward. Allis calls them outward and inward; but he always thinks and speaks of his man as lying on his back, and dislocations do not occur to men who are lying on the back. The bony socket is deepened by the cotyloid ligament. Allis aptly calls it the sucker ligament. Except in the extremes of motion the stability of the joint is not dependent upon the capsule *per se*, but upon atmospheric pressure and the normal tone of the muscles, some of which insert into the capsule.

The ligamentum teres has no mechanical significance. The capsule is a loose tube which extends from the rim of the socket, where it is strongest and thickest, to the base of the femoral neck. It checks excessive motion, offers an attachment for muscles and affords a base of support to the synovial membrane. The ilio-femoral ligament is the anterior portion of the capsule. It may be thicker than the Achilles tendon. It arises from below the anterior inferior spine and attaches to the intertrochanteric line and presents an outer and an inner fasciculus, the interval between them being so thin as to be translucent.

The pubo- or pectineo-femoral ligament is a shelving band of fibers which arises from the space between the pectineal line and the pubic spine, from which it passes out to blend with the capsule. It forms the floor for the femoral vessels, from which it is separated by the pectineus muscle. In the so-called obturator variety of dislocation downward, this ligament is uninjured. In the pubic variant of downward dislocation, it *may* be torn. Even this is unusual, and probably explains the immunity of the great vessels to injury in the vast majority of cases.

The ischio-femoral ligament arises from the side of the ischium where this bone meets the ilium and passes outward and downward to attach to the posterior intertrochanteric line. It sends one fasciculus or arm to the digital fossa and another to the base of the oblique line. Between these fasciculi is a sort of fascial web which supports the synovial mem-

FIG. I.

brane and attaches by loose connective tissue to the middle of the back of the femoral neck.

This structure may also escape damage in the type of dislocation under consideration. But if the usual procedure be followed and before reduction the obturator be transformed into an iliac dislocation, the ischio-femoral ligament must inevitably be destroyed and cicatrization result, most detrimental to ultimate function.

*The Vessels.*

In neither the downward nor the upward type of dislocation, if uncomplicated, are the great vessels jeopardized, but, as will appear later in this article, their relation to the femoral head (really the femoral neck) must constantly be borne in mind in attempting open operations for the relief of obturator dislocations. The same observation applies, with added force, to pubic dislocations.

*The Fascia Lata.*

That portion of the fascia lata which is pertinent to this discussion arises from the outer lip of the iliac crest. The anterior two-thirds of the gluteus maximus passes downward and forward to insert into it, while the tensor fascia passes downward and backward, also to insert into it. The fascia then passes over the great trochanter from which it is separated by a large bursa, and thence down the thigh as the ilio-tibial band to the outer tuberosity of the tibia. This ilio-tibial band is to all intents and purposes, a tendon. Because of these factors it must

FIG. II.

and does exert an inward thrust upon the trochanter, crowding the femoral head into the socket. Dr. Allis reports that having had his fascia lata divided transversely on the outer side of his thigh, because of a deep abscess, he noted that the head of his femur "became partially dislocated with each step and returned with a decided jar and audible sound." He adds, "By degrees the tensor muscles shortened and re-established their former control; but the security has never fully returned."

In his Surgical Anatomy, p. 564, Deaver says, "Contraction of the fascia lata after hip-joint disease, paraplegia, infantile paralysis, etc., may call for division either of the fascia alone or together with the contracted tendons"—an observation which must repeatedly have been made by every member of this society. When we come to consider the mechanical changes present in an obturator dislocation, we shall note that more than any of the lesions just mentioned, they present conditions which, if perpetuated long enough, are ideal for bringing about a contracture of this fascia.

Of the fascia lata, Allis says "This structure is not concerned to any material degree in the subject of dislocations of the hip;" but Allis was speaking of fresh dislocations. I am unable to interpret the ease with which a reposition, presently to be reported, occurred after division of the fascia lata, except on the assumption that in ancient obturator luxations adaptative shrinkage of this structure constitutes *one* of the prin-

FIG. III.

cipal hindrances to reduction. The fact that several operators have accomplished repositions only after stripping the trochanter of its soft parts (*Skeletierung*) seems to me to be contributory evidence in support of this contention.

*The Muscles.*

With iliac dislocations there is always some damage of the pelvitrochanteric muscles. The quadratus femoris is always torn. (I have found a record of one case (Humphry) where it apparently escaped.) The femoral head is not a discriminating dissector, and depending upon the direction and protraction of the dislocating force, it plows its way backward and upward between or through the members of the group comprising, besides the quadratus, the gemelli, the obturator internus, and the pyriformus. (There is no agreement at all on this point among the authorities reviewed. Dollinger in 17 cases found only the quadratus injured.) There is also a marked relaxation with consequent adaptative shortening of the long axial muscles of the limb, a fact which would warrant the contention of Drehmann, Brünning and others, that in cases of this group efficient traction should precede open operation.

Obturator dislocations, on the other hand, are associated with a minimal amount of muscular disturbance. There may be some slight shortening of the external rotators, but repeated measurements have convinced me that it cannot be great.

On the other hand, Szenes, who in 1918 (two years later than myself)

FIG. IV.

reduced an old obturator luxation by open operation after transforming it into an iliac dislocation, reports that he tore the shrunken quadratus and was compelled to cut the pyriformis. Incidentally his case, which was at first mobile, ultimately became ankylosed: this despite the fact that he found the socket empty and its cartilage intact, and in his after-treatment used approximately 23 pounds of skeletal traction. (Further evidence to support my contention that transformation of one luxation to another is a mistake.)

*The Sciatic Nerve.*

The sciatic nerve leaves the pelvis usually *below* the pyriformis, but sometimes through or above it, and passes from the sciatic notch across the internal obturator, the femoral neck, quadratus femoris and adductor magnus, to the popliteal space. The guide to it is the biceps which covers it, and with which it is loosely connected.

According to Allis, with the manipulative reduction by circumduction recommended by Bigelow, there is assurance of compressing the nerve between the femoral head and the pelvis, and danger of hooking it over the neck. Through this mischance the nerve has been pulled loose from its spinal attachment.

*The Mechanism of Dislocations.*

Since dislocations of the varieties under consideration regularly follow external violence, a glance at the skeleton will show that while the

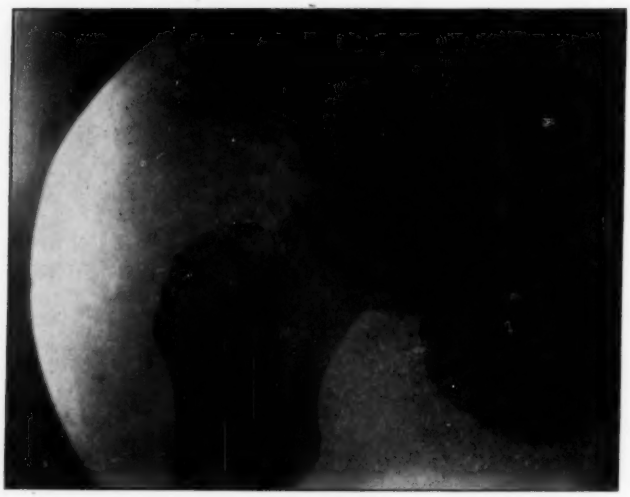


FIG. V.

weight and the power are the same, a wholly different fulcrum must be used in producing the dislocations of the two fundamental varieties. Dislocations inward *must* occur in hyperabduction—the shaft representing the power arm, the inferior capsule the weight, and the trochanter or neck in contact with the upper rim of the socket, the fulcrum. Given these three factors, simple hyperabduction alone can burst the inferior aspect of the capsule, and cause the head to rise up out of the socket to be displaced downward and inward to rest in the thyroid fossa. On the other hand, in outward dislocations a bony fulcrum does not present itself. The power arm and the resistance are the same as before, but the fixed point or fulcrum across which they work has to be the ilio-femoral ligament, but it can become so only if it is wound up tightly on the femoral neck. In this type of dislocation we know the head leaves the socket after rupturing the posterior capsule, and this can occur only through inward rotation (which tightens the anterior capsule) and flexion and adduction, which directs the head against the weakest part of the capsule at a shallow part of the socket.

The difficulty encountered in reducing either variety of fresh dislocation must arise principally from a failure to recognize the several steps by which the dislocation has come about. Were such a series of steps recognized in their proper sequence, by reversing them, no great difficulty should be had in leading the head back into the socket. And

indeed such has been the fact in the few fresh cases which have come within my personal knowledge, though it is only fair to add that these were all, except two, experimental dislocations on the cadaver. When the doctor knew what to do, there was no great difficulty in doing it.

On the other hand, the problem of the ancient dislocation is a wholly different one, for here muscle shortening, cicatricial contractions, and inflammatory changes have so changed both the character and the relations of the tissues that a reversal of the steps of the dislocation may be, and usually is, no longer possible.

To the best of my belief, the case presently to be detailed represents the only instance in which an ancient anterior or internal dislocation was reduced without either transforming it first into the iliac or external type, or stripping the trochanter subperiosteally or cutting away bony obstacles to reduction in the shape of part of the pelvic wall.

*The Case.*

On May 2, 1916, D. S., a very powerfully built young Irishman of about 26 years, was brought to me from Tonopah, Nevada, with the history that on the fourth of the preceding March, while he was mucking in a mine, he had been injured by a cave-in, approximately two tons of rock having fallen on or about him. Examination at the emergency hospital showed scalp wounds, excoriations and contusions of right shoulder and buttock, and a lacerated wound of right knee, which had freely opened the joint cavity. It was noted that the right thigh was held in abduction, outward rotation, and moderate flexion, but the significance of this distortion was not recognized. Treatment for the recognized lesions was efficient, and by the time he reached me they were healed without resultant disability.

I had never seen an obturator dislocation, but the appearance of the man was so characteristic, with his right thigh abducted, flexed, and rotated out, with pelvis tilted toward the side of the lesion, and body weight thrown on opposite leg, that from inspection it was possible to make a diagnosis without removing his clothes. The diagnosis was sustained by the x-ray.

On the following day an anesthetic was administered, and the man's pelvis was fixed after the manner suggested by Dr. Allis, by means of a rope passing from screws set in the floor above the levels of the anterior iliac spines and between the thighs. Then while traction was made on the flexed and abducted thigh, a direct outward thrust was made in the groin by the stockinged foot of an assistant. The thrust was continued while the limb was carried into adduction. This maneuver was com-

bined with both outward and inward rotation. When the last named combined movement was carried out, the femoral head could be lifted out of the thyroid fossa and jumped up onto the anterior or rather antero-internal rim of the socket. This fact was verified by the x-ray, a reproduction of which I shall presently show you. It was not possible to replace the head in the socket, however, though these manipulations and modifications of them were persisted in for upwards of two hours. The man came out of the anesthetic without any feeling of soreness or external evidence of trauma—but the operator was exhausted.

During the following eight days the man's skin from lower ribs to toes was cleansed daily with gasoline and alcohol, and in the intervals wrapped in sterile gauze. At the same time, through the courtesy of Dr. Russell Ryan, I was enabled to get control of a cadaver and reproduce in it as nearly as possible the pathological and mechanical problem presented by my patient.

It seems not amiss to interpolate here that the rigidity of an embalmed cadaver, and the friability of its muscles render it only partially possible to reproduce even the anatomical and mechanical conditions present in a living body which has sustained a dislocation.

I found when I had created a dislocation downward in my cadaver that the rigid soft parts very largely refused to follow the bones in their changed relations. Anatomically, it was the same thing, but it didn't look like it.

My attempts at manipulative reduction had given me the impression that the head had been prevented from returning to the socket by an annular constriction about the neck, and from my reading I had learned to expect that the head would be inclosed in an adventitious capsule, and that the socket would be filled up with organized inflammatory tissue.

The cadaver presented at least the advantage that I could experimentally test the methods by which other operators had attempted to solve the problem which such a luxation presented.

Dollinger, with the largest personal statistics published, had come to employ a posterior incision extending from the base of the trochanter backward between the fibers of the great gluteus to the posterior inferior spine.

This ought to be an admirable approach for iliac dislocations where one would come down at once directly on the head and at the same time have an easy approach to the socket, but in the obturator type, with the trochanter overlying the lower part of the socket and the external rotators covering most of the rest of it, while the deeply placed head is still

more difficult of approach, this incision was found on the cadaver to be difficult and inconvenient. Out of five obturator luxations operated upon by this method, Dollinger obtained two actual repositions, both of which ultimately ankylosed. This is, however, the incision which, either alone or in connection with other incisions, is oftenest employed.

The posterior curved convex forward incision of Kocher was studied. Except that it can be made to divide the ilio-tibial band, it presents no advantage over the Langenbeck cut.

Ollier's transtrochanteric convex downward incision was attempted. This incision, with an insignificant modification, was that advocated afterward by Mikulicz, and later still by Murphy. It gave an excellent exposure of the socket, but still left the head difficult of approach. Also the long period of postoperative immobilization necessary for the re-attachment of the trochanter rendered this incision undesirable.

The Lorenz incision between tensor fascia and sartorius was excluded because in an obturator dislocation with the bone displaced inward it would come down on the trochanter where it lay against the socket.

The Larghi incision, employed with satisfaction at the Bergmann Clinic, skirts the iliac crests and permits the glutei to be reflected downward. It would appear to be very like the Sprengel and Smith-Petersen incisions and, like them, to give an excellent approach to the socket, but the head and the structures which hinder its return to the socket would still be at an inconvenient distance. Also postoperative immobilization might have to be undesirably prolonged.

The Hüter-Schede incision was unknown to me until I began to write this paper, when I found it recommended by Drehmann (*Deutsche Zeitschrift für klinische Chirurgie*, 1904). In his case, however, he was in the end compelled to combine it with the posterior incision of Langenbeck, and to do a complete muscular denudation of the trochanter before he could obtain a reposition. For the following description of this incision I am obliged to my friend, Dr. F. Fehleisen, discoverer of the erysipelas germ. "The longitudinal incision begins below and a finger's breadth within the anterior spine, passes straight down for ten to twelve centimeters; then the inner border of the sartorius and the rectus are uncovered and retracted outward. Now while the limb is flexed, abducted, and rotated outward, the joint capsule is widely opened and the femoral neck uncovered."

This was the first part of the incision I employed in reducing my dislocation. The second or transverse portion was suggested to me by Dr. Osgood for an arthroplasty of the hip which I subsequently presented before this society at our meeting in San Francisco in 1915.

Briefly, the detail of the operation was as follows: A five-inch longitudinal incision beginning just below and within the anterior superior iliac spine was met at its lower end by a transverse incision extending three or four inches outward. The sartorius was drawn outward with the rectus. The fascia lata was cut across. The capsule was opened transversely. This exposed the socket, which was found to be free of adventitious tissue. A blunt pointed hernia knife was now introduced and carried inward until it encountered the head. The constriction about the neck was opened freely, cutting downward and backward.

With the idea that the reduction might now be made with skeletal traction, the trochanter was uncovered by a longitudinal incision, grasped with the largest size Lane forceps and strongly pulled upon while the limb was distracted, abducted, and flexed, and then adducted with inward rotation.

This maneuver failed. The left forefinger was now introduced into the cut in the capsule and carried out toward the head. A tense band was encountered lying directly across the inner pole of the head. Pulsation was sought for but could not be felt; so the knife was introduced alongside of the finger and this band sawn through. It was exceedingly hard to cut. The Allis maneuver was again repeated, and the head at once entered the socket. It was now noted that the right-angled flap in our wound had become a sharp V.

Because of the extensive traumatization it was thought best to carry a gutta percha and gauze drain from the head out through the longitudinal cut over the trochanter. The capsule was not sutured, as the parts came together evenly. The external wound was sewn up tight and a double plaster of Paris spica applied.

The drain was removed in 40 hours and culture taken. It was found to be sterile. The lower portion of the V-shaped flap sloughed. A culture from it, taken as soon as the slough was discovered, was sterile. The site of the slough was eight weeks granulating. The white blood count rapidly fell to normal. The temperature never reached 100 degrees F.

The man was got up with a short spica and crutches by the end of the sixth week, and the spica removed two weeks later.

This patient was a State Compensation case, and not a very desirable citizen. When he learned that unusual interest attached to his case, he became difficult to handle. He could not be induced to flex his thigh beyond 30 degrees, though on November 8, six months after the operation, under anesthesia, I was able to flex it with no great effort to between 60 and 90 degrees. (When he waked up he had no notable discomfort.)

But I made the grave mistake of not immobilizing it in this position until the gain was permanent.

It is my judgment first that I should have immobilized his thigh in adduction and right-angled flexion, and second that I should not have held it in that position longer than two weeks, but should then have extended it to within a few degrees of a straight angle for a week, and then held it another week or two in flexion. I should then have got him up without apparatus and begun at once with my physiotherapy. Finally, when I got his thigh freely flexed on November 8, it was a grave oversight not to immobilize it in that position till the gain had become permanent. In that way I would have saved the man many months of partial disability, and my employers much disability compensation.

Not caring to trust my own judgment of my own work, I asked Dr. Sherman to examine him and give a prognosis of the ultimate outcome. His report follows:

"The Nevada Industrial Commission, Carson City, Nevada.

January 8, 1917.

Gentlemen:

I beg to submit herewith the report on my examination of D. S., whom I saw at the instance of Mr. J. J. Mullin and Dr. James T. Watkins:

This was a man upon whom Dr. Watkins had operated very successfully for obturator dislocation of the hip. He came for an estimate of his disability, present and prospective. At present the man can walk well; can sit down; can stoop about half; can squat about an eighth. He has about twenty degrees of flexion, fifteen degrees of abduction, a hundred and eighty degrees of extension, and fifteen to thirty degrees of rotation out and in. He is debarred from occupations requiring squatting, complete stooping or kneeling. He is competent only for occupations which permit of his standing or walking.

His general availability then for any possible occupation is about twenty-five per cent.; his disability seventy-five per cent.

Now, the range of motion in his hip can be increased almost to the full limit if the man will make the effort. Therefore, his prospective disability is very much less than his actual present disability, and should not be, I think, more than about fifteen or twenty percent. I am,

Very respectfully yours,

(Signed) HARRY M. SHERMAN."

I am more glad than I can say—or you can know—to close this record of what would seem to have been an unusual case, with these words of commendation from a man long an ornament of this society, and at whose feet I sat with profit for twenty years.

DISCUSSION OF DR. WATKINS' PAPER.

Dr. Frederick Gaenslen, Milwaukee, Wis.: I wonder whether Dr. Watkins considered the incision of Ludloff, recommended for open operation on congenital dislocation of the hip, and also for arthrodesis of the hip. My experience is limited to one case in which I used this incision for an arthrodesis. I extended the incision downward with the leg in complete abduction and in rotation outward of 90°, and in that way I exposed the head in about the position I wanted it to correct the obturator dislocation. The approach is intramuscular, and no vessels of any size are encountered. After dislocating the head through the wound, towels can be clamped around the head, so that it sits upon the operating field as a billiard ball sits on the table, and you can readily denude the cartilage. The approach to the acetabulum is very good. I would like to ask Dr. Watkins if he considered that.

Dr. Fred Albee, New York City: I believe that Dr. Watkins very wisely devoted a large portion of his paper to the approach to the hip. I do not believe that in any part of surgery is the approach so important as in the surgery of the hip-joint. I had a few cases of dislocation and one of fracture-dislocation where not only was the hip dislocated in the position Dr. Watkins mentioned, but the head of the femur was broken off and lying beneath the gluteal muscles. In such cases I believe one should approach the hip-joint in the very best way he can, and then from that he can work to the dislocated head. Now the anterior incision Dr. Watkins mentioned will give a very good exposure of the parts in a thin subject, but in a very fat subject it gives a rather inadequate approach, and I believe if you extend that incision posteriorly similar to the Smith-Petersen approach, and to the Ambler operation, peeling off the muscles, you can increase your exposure as much as you like, and you will work easier and avoid traumatization by the practices of your assistants. I believe it will improve the approach. As far as the approach goes, in my own work I use two approaches, one an anterior approach for fractures of the neck of the femur, and the Smith-Petersen approach.

I congratulate Dr. Watkins very much upon the result. It is certainly a difficult surgical problem in a dislocation such as this of two or three or four months' duration.

Dr. James T. Watkins, San Francisco (closing the discussion): Endlich attempted the approach suggested by the Doctor without success. He ultimately reduced his dislocation through a posterior incision after he had chiselled off the inner aspect of the socket. Apparently he got a miserable immediate result, but noted that the man, who was a wood chopper, with a large family to take care of, ultimately walked with a pretty good leg. My impression is that Dollinger also tried that incision without result. I note what Dr. Albee says about fat patients. As you see by my pictures, my patient was fairly stout. I was compelled to do all of the deep work in this operation guided only by the sense of touch. One couldn't see anything. The

Germans have a good deal to say about the adventitious capsule which forms about the head of the femur in its new position and in which appeared many pieces of new bone. Some of them, too, were constrained to drain this adventitious capsule after they had reduced the dislocation, fearing that it would fill up with blood and ultimately become infected. I did not pay any attention to it. In fact, if there was such an adventitious capsule, it escaped my notice. One hesitates to generalize on the basis of what experience can be had from a single case, but it seems to me that the thing I got out of this study was that with old anterior dislocations our problem implies an attack upon hindrances to the return of the head which are essentially ligamentous, whereas in the posterior type the main obstacle to be overcome must be muscular contractures.

# RETARDATION OF GROWTH FOLLOWING POLIOMYELITIS.

BY PHILIP W. NATHAN, M.D., NEW YORK, N. Y.

It is, of course, well known that growth is retarded after all forms of acute illness, particularly after infectious diseases. As a rule the retardation is not great and only temporary. But in some cases,—for instance, following typhoid,—the biological processes remain depressed for a long time and the growth of the individual is slow; the adult individual never reaches the full height. It goes without saying that in severe cases of poliomyelitis similar abnormal biological conditions and their sequelae prevail, so that it is to be expected that, for a time at least, children who have had a severe attack of this disease will, at least temporarily, remain behind their normal fellows in the rapidity of growth. This is most graphically demonstrated in twins of which only one of the children has been afflicted. In two examples that I have had under observation, the retardation of growth was considerable, although the affected child recovered without paralysis.

This general retardation of growth is not specifically mentioned by writers upon poliomyelitis, but I have no doubt it is well known to the majority of orthopaedic surgeons who see a great many cases of poliomyelitis, and I do not think it necessary, for the present at any rate, to demonstrate the actual conditions mathematically.

On the other hand, although retardation of growth in the paralyzed limb is always mentioned in the text books, the peculiarities of the condition and its actual relation to the paralysis and the trophic conditions are not, as far as I have been able to ascertain, fully discussed. In the course of examining many children with infantile paralysis, I have noticed that: (1) the shortening when present bears no direct relation to the number of muscles paralyzed. I have seen, for instance, many children with practically no voluntary power in the limb but without demonstrable shortening, though the condition had existed for a long time. On the other hand, there were others who had definite shortening who had lost very little power and that in only one or a few muscles. (2) The shortening bears no direct relation to the vaso-motor disturbance present. I have seen many children with mottled and cold extremities and recurrent ulceration in whom the affected limb was equal with its fellow.

However, although the retardation of growth bears no relation to the number of muscles paralyzed or the vaso-motor disturbance, it seemed to me there existed a fairly constant relation between the shortening and the paralysis of certain muscles. I found that in adults or older children, in whom the morbid conditions had existed for many years, a short leg always meant gastrocnemius, associated with or without tibialis posticus, palsy.

In these cases there was some atrophy of the limb and, in a very few, paralysis of other muscles, but the shortening so often accompanied gastrocnemius and tibialis posticus palsy without any other marked disturbance of voluntary muscle power, that it occurred to me there might be some causal relation between the two.

In order, if possible, to determine the actual correlation between the retardation of growth and the paralysis of the limb or other factors to be considered, I tabulated the cases from the 1916 epidemic in the poliomyelitis service of the Mount Sinai Hospital with this point in view. One hundred twenty cases from the 1916 epidemic originally attended this clinic. Forty cases no longer attend and 10 cases still attending who have practically no lost function need not be considered here. We have then, 70 cases with definite signs of paralysis, of which 15 have shortening of one inch or more within five years of the onset. These cases are tabulated below.

| Name<br>Number<br>Age | First Shortening | Final Shortening | First Atrophy | Final Atrophy | Paralysis | Final Shortening<br>Years | Ins. |
|---|---|---|---|---|---|---|---|
| | 1918 | 1921 | 1918 | 1921 | | | |
| | R. A. 16½ | R. A. 20½ | R. T. 10 | R. T. 9½ | | | |
| 1 | L. A. 17⅝ | L. A. 22½ | L. T. 11½ | L. T. 12 | Gastroc.— | | |
| S. A. | | | R. C. 5½ | R. C. 5½ | Tib. Post.— | 5 | 2 |
| | | | L. C. 7½ | L. C. 6½ | Calc. Valg. | | |
| | 1920 | 1921 | 1920 | 1921 | | | |
| 2 | R. A. 20½ | R. A. 21 | R. T. 11 | R. T. 11 | | | |
| 17 mos. | L. A. 19¾ | L. A. 19¾ | L. T. 8¼ | L. T. 9 | Gastroc.— | | |
| | | | R. C. 8½ | R. C. 8½ | Tib. Post.— | 5 | 1¼ |
| | | | L. C. 5½ | L. C. 5½ | Calc. Valg. | | |
| | 1921 | 1922 | 1921 | | | | |
| 3 | R. A. 19 | R. A. 19⅞ | R. T. 10½ | Not noted | | | |
| F. B. | L. A. 18 | L. A. 18⅞ | L. T. 9½ | | Tib. Post.+— | 6 | 1 |
| 4 years | | | R. C. 7½ | | Gastroc.+— | | |
| | | | L. C. 6½ | | | | |
| | 1918 | 1921 | 1918 | 1921 | | | |
| 4 | R. A. 14½ | R. A. 20 | R. T. 10½ | R. T. 12¼ | | | |
| F. C. | L. A. 14½ | L. A. 19¼ | L. T. 9⅛ | L. T. 11 | Tib. Post.—+ | 5 | ¾ |
| 14 mos. | | | R. C. 7¼ | R. C. 8½ | Gastroc.—+ | | |
| | | | L. C. 6 | L. C. 7½ | | | |

| Name<br>Number<br>Age | First Shortening | Final Shortening | First Atrophy | Final Atrophy | Paralysis | Final Shortening<br>Years In |
|---|---|---|---|---|---|---|
| | 1920 | 1922 | 1920 | 1922 | | |
| | R. A. 23¼ | R. A. 25 | R. T. 13¼ | R. T. 13¾ | | |
| 5 | L. A. 23¼ | L. A. 23¼ | L. T. 10 | L. T. 9¾ | Gastroc.—+ | 6 1¾ |
| E. M. | | | R. C. 9 | R. C. 9 | Tib. Post.—+ | |
| 3 years | | | L. C. 7¼ | L. C. 7½ | | |
| | | | | 1921 | | |
| 6 | | 1921 | | R. T. 12¼ | | |
| E. F. | Not noted | R. A. 23 | | L. T. 14½ | Gastroc.++ | 5 1 |
| 3 years | | L. A. 24 | Not noted | R. C. 8 | Tib. Post.—+ | |
| | | | | L. C. 10¼ | | |
| | 1918 | 1922 | 1918 | 1922 | | |
| 7 | R. A. 20½ | R. A. 24 | R. T. 11 | R. T. 12 | | |
| J. F. | L. A. 20½ | L. A. 24⅞ | L. T. 9½ | L. T. 10½ | Gastroc.—+ | |
| 4 years | | | R. C. 7½ | R. C. 10 | Tib. Post.—+ | 6 ⅛ |
| | | | L. C. 6 | L. C. 6¾ | Peronei, sl. | |
| 8 | 1919 | 1921 | 1919 | 1921 | | |
| E. F. | R. A. 19 | R. A. 20⅜ | R. T. 13 | R. T. 13 | | |
| 2½ yrs. | L. A. 19¾ | L. A. 21⅜ | L. T. 13½ | L. T. 14 | Gastroc.—+ | |
| | | | R. C. 8 | R. C. 9 | Tib. Post.—+ | 5 1 |
| | | | L. C. 9 | L. C. 10 | Ex. Dig., sl. | |
| 9 | 1920 | 1921 | 1920 | 1921 | | |
| F. G. | R. A. 23 | R. A. 25½ | R. T. 13 | R. T. 15 | | |
| 3 years | L. A. 22½ | L. A. 23 | L. T. 11½ | L. T. 13 | Gastroc.— | |
| | | | R. C. 9 | R. C. 10 | Tib. Post.— | 5 1½ |
| | | | L. C. 7½ | L. C. 7½ | Calc. Valg. | |
| | 1918 | 1921 | 1918 | 1921 | | |
| 10 | R. A. 18¼ | R. A. 20¾ | R. T. 11¼ | R. T. 13 | | |
| Y. H. | L. A. 17½ | L. A. 19⅞ | L. T. 10 | L. T. 11½ | Gastroc.+— | 5 ⅛ |
| 2 years | | | R. C. 8 | R. C. 9 | Tib. Post.— | |
| | | | L. C. 6½ | L. C. 6¾ | | |
| | 1918 | 1921 | | 1921 | | |
| | R. A. 20½ | R. A. 22½ | | R. T. 9 | Flex. L. Hal.— | |
| 11 | L. A. 22 | L. A. 24 | Not noted | L. T. 13 | Gastroc.— | |
| J. J. | | | | R. C. 6¼ | General weak- | |
| 1 year | | | | L. C. 9¼ | ness entire limb | 5 1½ |
| | | | | | but performs | |
| | | | | | functions | |
| | | 1921 | | 1921 | | |
| | Not noted | R. A. 19 | | R. T. 9 | | |
| 12 | | L. A. 20 | Not noted | L. T. 9¾ | Gastroc.—+ | 5 1 |
| J. L. | | | | R. C. 6½ | | |
| 10 mos. | | | | L. C. 8 | | |

| Name Number Age | First Shortening | Final Shortening | First Atrophy | Final Atrophy | Paralysis | Final Shortening Years | Ins. |
|---|---|---|---|---|---|---|---|
| | 1921 | 1922 | 1921 | 1922 | | | |
| 13 P. L. 3 years | R. A. 19<br>L. A. 18 | R. A. 20⅜<br>L. A. 19¼ | R. T. 13<br>L. T. 10<br>R. C. 8½<br>L. C. 6½ | R. T. 12½<br>L. T. 9½<br>R. C. 9<br>L. C. 7¼ | Gastroc.—+<br>Tib. Post.— | 6 | 1¼ |
| | 1920 | 1922 | 1920 | 1922 | | | |
| 14 F. L. 8 mos. | R. A. 21¼<br>L. A. 20¼ | R. A. 23<br>L. A. 21¾ | R. T. 13¾<br>L. T. 11½<br>R. C. 9<br>L. C. 7¼ | R. T. 13¾<br>L. T. 12½<br>R. C. 9<br>L. C. 7½ | Gastroc.—<br>Tib. Post.— | 6 | 1¼ |
| | 1919 | 1921 | 1919 | 1921 | | | |
| 15 A. M. 3½ yrs. | R. A. 19½<br>L. A. 19⅞ | R. A. 23<br>L. A. 23½ | R. T. 11½<br>L. T. 11¼<br>R. C. 6<br>L. C. 7⅝ | R. T. 13½<br>L. T. 13½<br>R. C. 6½<br>L. C. 9 | Gastroc.+—<br>Quad.+— | 5 | ½ |

A glance at this table establishes the fact that all the children with short legs have the gastrocnemius involved. In one case the paralysis involves the gastrocnemius alone; in 10 the gastrocnemius and the tibialis posticus were the only paralyzed muscles; in one the gastrocnemius and the peroneii; in one the gastrocnemius and the extensor longus digitorum slightly; in one the gastrocnemius and the quadriceps partially, and in one the gastrocnemius was associated with paralysis of the flexor longus hallucis and general weakness of the limb.

Of the remaining cases, 10 had paralysis of both legs, and of these, two, with more or less general paralysis, had shortening of one-half inch five years after the onset. In none of the 54 unilateral cases without shortening was the gastrocnemius definitely involved, and in only two was the tibialis posticus associated with the other muscles paralyzed. I think the findings in these cases confirm my impression that there is a more or less definite relationship between gastrocnemius or gastrocnemius and tibialis posticus palsy and retardation of growth in the affected limb in poliomyeltis. Theoretically it would seem that the origin of the gastrocnemius near the lower femoral epiphysis and the loss of stimulation due to its absence would explain the connection. But the actual measurements show that the retardation of growth is not in the femur at all but in the leg, so that this factor must be eliminated. Nor can the loss of function in the gastrocnemius be the only deciding factor in the retardation of growth of the lower epiphysis of the tibia and fibula.

The os calcis, it is true, no longer rotates on the articular surface of

the tibia, but the individual still walks on the heel, and the stimulating influence of stress in this region persists, though the gastrocnemius is relaxed.

Thus the cases in this series definitely show that gastrocnemius and tibialis posticus palsy almost invariably lead to retardation of growth in the epiphysis (probably the lower) of the leg, while the growth in the other epiphyses remains unaffected. Though the causal relation between the paralysis and the retardation of growth is not elucidated, it is certain that it is not due to vaso-motor disturbance nor can it be due entirely to abnormal mechanical conditions.

In contrast to the constant retardation of growth when the above-mentioned muscles are paralyzed is the fact that there is practically no retardation of growth when the limb as a whole, with the exception of these muscles, is paralyzed or when there is marked paralysis of the muscles of the thigh or the muscles of the fore part of the foot. The careful measurements taken in this group of cases bear out the impression of years of experience with poliomyelitis; for although I have in my records cases in which there was lengthening, I can find only a single case of general paralysis of the whole leg in which there was shortening, and in this the gastrocnemius and the tibialis posticus were completely paralyzed with the other muscles.

The cause for this peculiarity I hope to show in a future communication.

# ON COXA PLANA AND ITS CAUSATION.

A Theory Presented to the American Orthopedic Association in Washington, D. C., on the 2nd of May, 1922.

BY DR. MURK JANSEN OF LEIDEN, NETHERLANDS.

The femoral head and neck, when being deformed to the condition which was first described by Dr. Legg, pass through the following phases:

Fig. I.

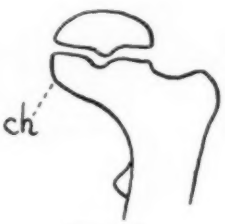



Fig. II.

Fig. III.

Fig. IV.

Starting from the normal condition, represented by Fig. I, the growth disc is seen to approach the horizontal position (Fig. II) and the femoral neck at the same time tends to develop a "chin"-shaped protrusion (*ch* Fig. II). Moreover, the head often shows a lateral displacement, its lateral edge projecting beyond the lateral border of the neck ("*head-in-neck*" position), and slight irregularities in the plane of the growth-disc may present themselves. Next a widening out of the neck and a flattening of the head become noticeable (Fig. III), until after some trauma or an intercurrent disease, or also without any traceable reason, the femoral head shows excessive flattening with fragmentation of its bone centre (Fig. IV), when *coxa plana fragmentata* is developed.

FIG. V. Normal Socket.

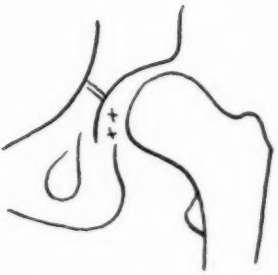


FIG. VI. Shallow Socket (through thick socket floor).

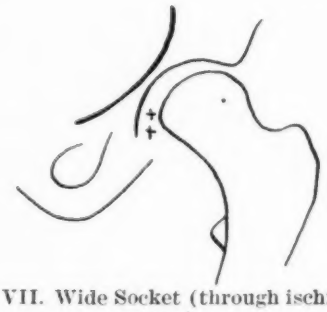


FIG. VII. Wide Socket (through ischium varum).

On further growth these fragments reunite and form a wide femoral head in the adult.

It has hitherto escaped the attention of investigators that besides these phenomena in the femoral head and neck the *socket* regularly shows characteristic changes. In all our cases, and in many cases represented in literature, we have found either the floor of the socket too thick, *i.e.*, we found a socket which is too *shallow*, or a socket which is too *wide*, due to the fact that the ischium is swung medially over a few degrees so that the ischial part of the acetabulum is displaced medially—a condition we term *ischium varum*. Though in the case of a too thick socket-floor the socket is primarily too shallow, and in ischium varum the socket is primarily too wide, in both cases the socket is part of a sphere too wide for the head. In both cases the socket is too shallow, and might be shortly spoken of as *flattened socket*. These changes in the acetabulum alter the mechanical conditions in the femoral head and neck, and of these mechanical changes the development of the symptoms of coxa plana will seem to be the natural result.

In the erect posture the wide and shallow socket is in contact only with

the upper portion of the femoral head, a gap being left between the medial part of the head and the socket. (It is understood that the upper portion of the socket is normal, running practically in a horizontal direction.) The functional stresses which are normally transmitted from the whole of the socket surface to the whole of the femoral head, and reversely, are thus concentrated over a small area of head and socket.

The resultant of these stresses normally coincides with the axis of the femoral neck, as may be gathered from the internal structure of the femoral head and neck. This resultant may be separated into a vertical component, *v* (Fig. VIII) and a transverse component, *t* (Fig. VIII), each of which seems to be responsible for the development of a certain group of symptoms in coxa plana:

The *vertical stresses* thronging into the femoral head through the small area of its surface that is in contact with the socket are transmitted through the femoral neck largely by the bone-elements, *a* (Fig. IX) passing through the lateral part of the growth-disc. These are, therefore, made to bear undue pressure, the effect of which is to be expected both in the growth-disc—*i.e.*, in the way new bone is to be formed—and in the bone substance that has been formed previously. The medial part of the growth-disc, normally transmitting stresses through the bone-elements *b* (Fig. IX) is relieved of such stresses. Hence there is an increase of pressure on the lateral part of the growth-disc and a decrease of pressure on the medial part during the erect postur in subjects with a flattened acetabulum. It is well known that increase of pressure may lead to decrease of growth and decrease of pressure to increase of growth, and we have brought forward grounds for the assumption that this is

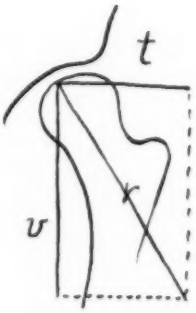



FIG. VIII.

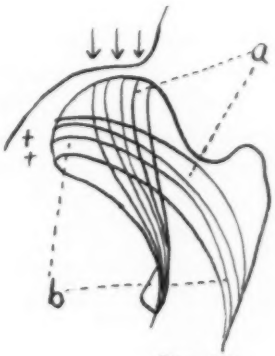



FIG. IX.

especially apt to occur in subjects whose power of growth has been enfeebled by some injurious agent that has befallen them either before or after their birth.[1] The development of knock-knee is a classical illustration of this. The undue pressure through the lateral portion of the growth-disc of the femoral head and the diminution of pressure in the medial portion may, therefore, contribute to displacing the growth-disc into the horizontal position and even to the formation of the "chin" (*ch* Fig. II) on the inner border of the neck. In a study "On Bone Formation"[2] we have brought forward arguments favoring the assumption that apart from growth changes, bone (that has been previously formed), when submitted to undue weightbearing, may absorb lime salts and become plastic. The concentration of the vertical stresses through the lessened area of femoral head and neck, *i.e.*, through the bone-elements *a* (Fig. IX), means undue weight bearing to them. Thus the shortening and thickening of the femoral neck and the flattening of the head may be the result of this excessive pressure. And as this pressure makes itself felt in the lateral portion of the neck, it may also have a share in the horizontal position of the growth-disc through compression apart from growth. The manifestation of this share may be found in the fact that the *growth-disc* is distinctly *curved* in many of the completely developed cases of coxa plana, its lateral portion being displaced more downward than the medial portion.

The forces of the *transverse component t* (Fig. VIII) originate on or near the trochanters and push the femoral head medially along the upper surface of the socket. They evoke shearing stresses between head and neck in the growth-disc, and these may account for the lateral displacement of the head as well as for the irregularities in the growth-disc.

As the femoral neck is getting wider and thicker, the growth-disc is spread out over an ever-enlarging area. It, therefore, seems plausible that rents should develop in it, and the same holds good for the bony part of the femoral head.

Thus shallowness of the acetabulum may be made responsible for all the characteristic symptoms of coxa plana, if it is assumed that bone in its growth and in its formation responds to enhanced mechanical stresses following certain rules which we have tried to lay down in the studies quoted in the above. Or shortly: *flattened head* seems to be *due to flattened socket*.

With the widening out and flattening of the head its form draws nearer and nearer that of the socket. This means a diminution of the

incongruence of head and socket, an enlargement of the area of contact, *i.e.*, of the area available for the transmission of stresses. The whole of the development of coxa plana, therefore, appears to us as a manifestation of the power of mutual co-aptation of the articular ends, a power which must be admitted to exist in all joints, and which shows itself to excess only in the congenital incongruence of the normally relatively heavily burdened femoral head and neck, as has been described in the above. This view is corroborated by the fact that the roof of the socket often shows changes which are equally characteristic of such an attempt at co-aptation.

The co-aptation, however, often remains incomplete in many cases of flattened socket and head. This is shown by the fact that adults relatively often present themselves with all the symptoms of flattened socket and head in which, nevertheless, the characteristic phenomena of joint-wear have developed. In them the fragments of the head have reunited and the growth-disc has naturally disappeared, but the joint line is too narrow in the upper part, indicative of the fact that the joint cartilage is worn off in that region, the outcome of local wear due to the insufficiency of co-aptation. This and the lipping which may be present in the borders of socket and head mark the condition as one of "joint-wear," —officially, though not appropriately, called "osteo-arthritis."

It is well known that coxa plana is a satellite of congenital dislocation of the hip, and reversely. It will occur with congenital dislocation of the hip in the same individual or in the same family,—for instance, coxa plana on one side and congenital dislocation of the hip on the other side of the same individual, or congenital dislocation of the hip in the mother and coxa plana in the daughter. With relatively high frequency also coxa plana will develop after reduction of congenital hip-dislocation. This co-relation may be easily understood, if for the thick socket-floor and for ischium varum the same cause is assumed that Le Damany has pointed out for congenital dislocation of the hip:—the amniotic sac, which remains too small and flexes the hip to excess, levers the femoral head out of the socket, the pelvic border acting as a fulcrum, and causes congenital dislocation of the hip (Le Damany). If there is less pressure from the amniotic sac, there may be just enough to lessen the normal pressure of the head against the socket-floor and to prevent the normal deepening of the socket, thus leaving too thick a socket-floor. And in other cases, too small an amniotic sac may be drawn too tightly over the sitting bones, and bend both of them inward, if the pelvis is lying symmetrically, or bend only one of the sitting bones inward if the pelvis is

not lying symmetrically, but lower on that side. Thus flattened socket, either through too thick a floor or through ischium varum, may be classed among the congenital malformations brought about by too small an amniotic sac.

It need hardly be mentioned that too thick a socket-floor, which is constantly present in the reduced congenitally dislocated hip, will favor the development of coxa plana. It also stands to reason that too thick a socket-floor is sometimes found to be combined with ischium varum on the same side, and means enhanced chance for the development of coxa plana.

Some investigators have tried to make microbes responsible for the development of coxa plana, and while some have sought in vain for bacteria by open operation, in a small number of cases bacteria have been cultured from coxa plana. This is not in contradiction to the mechanical nature of the condition. In every tissue, indeed, that is broken or torn mechanically, the chance is enhanced for bacteria, circulating in the body, to settle down and develop at the site of damage. However, a number of facts are opposed to the assumption that bacterial inflammation should be an essential factor in the development of coxa plana, because:

1. Patients with coxa plana are regularly distinguished from those with bacterial inflammations by their healthy appearance, the small amount of pain, the absence of fever, and mostly also by the absence of reflex stiffness and restriction of movement throughout life, except that which is brought about mechanically by the thickening of head and neck;

2. Bacteria cannot explain the thickness of the socket-floor or the ischium varum, the "head-in-neck" position, the horizontal position of

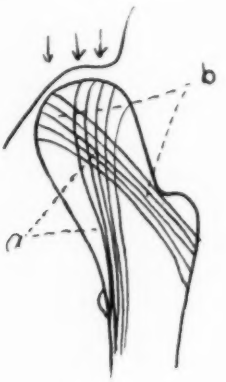



FIG. X.

the growth-disc, and the co-relation with congenital dislocation of the hip.

It should be noted that the flattening of the head does not in all cases pass through the four stages represented in Figs. II-IV. Cases of incomplete flattening in adults with flattened socket are not rare. The reasons may be different. The stronger the individual, *i.e.*, the less his power of growth is enfeebled, the better will head, growth-disc, and neck be able to resist the unusual stresses. Moreover, periods of rest may have been a factor in the arrest of the deforming process. Furthermore, congenital coxa valga, a frequent associate of flattened socket and of congenital dislocation of the hip, shows a tendency to preserve the normal shape of the head and neck in cases of flattened socket. This may be understood if it be borne in mind that, in proportion as the femoral neck draws nearer the vertical position, more of the convex-sided bone-elements *b* (Fig. X) are made to transmit pressure both to the medial and the lateral side of the neck, thus relieving the concave-sided elements *a* (Fig. X) of their excessive weightbearing. Reversely, as the femoral neck departs from the valgus position, its convex-sided bone-elements are more relieved from weightbearing, which to them means atrophy and to head and neck increased tendency to develop coxa plana.

As the femoral neck approaches the varus position in cases of flattened socket, it tends to an increase of the varus position or even to a fracture of the neck. We have repeatedly observed coxa vara or fracture of the neck on one side of a boy or girl with flattened socket on that side and a normal hip on the other side. This may be due partly to the above atrophy of the convex-sided bone-elements, partly also to the fact that in coxa vara the direction of the concave-sided elements *a* (Fig. XI) does not—as it practically does in coxa valga—coincide with that of the

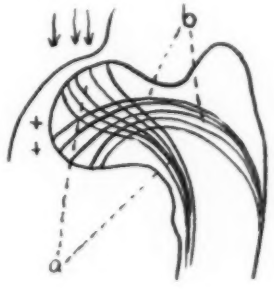



FIG. XI.

vertical stresses, and lastly also because the moment of the vertical pressure on the head becomes greater as the neck approaches the horizontal position. Thus monolateral coxa vara, which has been hitherto unexplained, may be understood, when it is attended by a flattened socket which, for that reason, bears weight only on the upper portion of the femoral head. It is needless to say that here again enfeeblement of the power of growth favors the development of either varus-position or fracture.

All in all, flattened socket (either due to ischium varum or to thick socket-floor) may be made responsible for a large number of changes in the femoral head and neck by the application of rules we have tried to establish for the formation and growth of bone, and the primary cause may be identified with that of congenital hip-dislocation, with which these changes appear to be co-related.

As for the treatment, it should be borne in mind that the process met with in coxa plana is an attempt at self-help of nature to do away with an incongruence of head and socket. Undesired plasticity of head, neck, and socket should be forestalled or checked by rest, eventually combined with traction. It may be assumed that bone which has become plastic through undue weightbearing will deposit new lime-salts and become firm again when it is relieved of weightbearing for a number of months, after which gradually increasing weightbearing may be allowed. In most cases the relief of weightbearing may be combined with free movement of the hip either in recumbency or in walking with crutches with a mitten under the well foot. Coxa vara, as well as fracture of the neck, requires special measures.

REFERENCES.

1 Jansen, Murk: Feebleness of Growth and Congenital Dwarfism. Oxford Medical Publications.
2 Jansen, Murk: On Bone Formation. Manchester University Press.

DISCUSSION ON PAPER OF DR. JANSEN.

DR. D. B. PHEMISTER, Chicago: I shall limit myself in the discussion of this interesting paper to the presentation of two cases which show the possible relationship between infection and the development of the changes in coxa plana. They support the contention that the primary lesion may be an epiphysitis of the head of the femur and that the subsequent changes are secondary to a breaking down of the bony center and collapse of the cartilaginous head.

The first case, previously reported (Operation for Epiphysitis of the Head of the Femur (Perthes' Disease), Findings and Result, *Archives of Surgery*, 1921, Vol. ii, p. 221), is that of a boy 10 years of age who entered the Presbyterian Hospital of Chicago with a typical history and physical findings of

coxa plana of the right hip of five months' standing. An x-ray picture showed flattening of the head with an area of reduced density in its central portion. He left the hospital without treatment and returned four months later, when a second x-ray picture showed more marked collapse of the head and extensive destruction of its center of ossification with two irregular dense shadows suggesting the presence of sequestra. An operation was performed in order to determine the nature of the changes and the effect of cleaning out the broken-down center of ossification. The joint was exposed anteriorly, several c.c. of a straw-colored fluid were aspirated and the synovial lining was opened. A mild synovitis was found with several synovial tags. The articular cartilage of the head was smooth and shiny, but bulged markedly in its lateral portion. A window was excised from the anterior portion, which exposed a broken-down center of ossification filled with necrotic débris and containing numerous sand-like particles of necrotic bone as well as two definite sequestra about the size of peas. After curettage of the epiphyseal head, the hip-joint was closed and a plaster-of-paris cast applied for two months. Aerobic cultures made of the synovial fluid and of the tissues removed from the head were negative. No anaerobic cultures were made. Histologic examination of the synovial lining showed a chronic synovitis with areas of round-cell infiltration. Sections of the material removed from the head showed a mixture of granulation tissue in various stages of organization and necrotic débris containing numerous small sequestra. Microscopic examination of the pea-sized masses of bone showed them to be made up entirely of dead bone. There was absence of tubercle bacilli in sections stained for them. My interpretation is that the process was a quiescent inflammatory one.

X-ray pictures made two and five months after the operation showed a rapid re-formation of the bony center with the cartilage in the same position of collapse as at the time of operation. Other pictures taken in the course of the two years following showed a complete disappearance of the active signs of disease and there is a fair range of motion in the joint. The rapid reorganization and ossification without further flattening, which followed operation, suggest the advisability of operation in cases that are seen comparatively early and show marked evidences of destruction with sequestration.

The second was a case of Dr. G. L. McWhorter's, a boy 10 years of age, with chronic nasal infection, who was admitted to the Hospital thirty-six hours after the onset of symptoms. He had pain and rigidity in the right hip, a temperature of 100.6 degrees and a leucocytosis of 19,000. Osteomyelitis of the upper end of the femur was diagnosed and the base of the neck and the shaft of the femur three inches below the trochanter were exposed and cut into with negative findings. Cultures of tissues removed from the neck yielded one colony of staphylococci, which was in all probability the result of contamination. The disease ran a mild febrile course for 10 days and the wound healed in three weeks with little evidence of infection. X-ray pictures taken two weeks after the onset showed slight flattening of the femoral head wih irregular margins and increased density of the convex portion of the center of ossification in the epiphysis. Eight months later a second x-ray picture showed typical findings of coxa plana.

The histologic findings in the first case and the clinical picture at the onset of the second case suggest that in both of these instances the disease was inflammatory in nature.

Dr. A. H. Freiberg, Cincinnati: For me to speak at any length on this subject would be, I think, a great injustice to the rest of the program for the day.

I cannot refrain from expressing my very great gratification and pleasure at hearing the paper of our esteemed visitor and colleague, Dr. Jansen. It would not be becoming in me to say anything very critical of what has been presented to us this morning in so very interesting a way, because I have not had the opportunity of thinking about it carefully in the degree which it merits. The thing that must strike every one who examines a number of such pelves and hips as the orthopaedic surgeon is doing is that it is incumbent upon us to distinguish between cause and effect. A considerable number of observers have studied this subject. Some years ago I myself cast upon an unsuspecting medical world a paper on the theory of this disease. This condition is looked at from different points of view. We have several men who look at this condition as preëminently of traumatic origin. This was the view our distinguished colleague, Dr. Legg, had when he gave us the first description to be found in the literature, or at least as early as any to be found in the literature. The condition found in congenital hips which had been subjected to considerable trauma I shall not discuss at this time. You will see from the slides that there is very much to recommend Legg's views. We have the infectious view which Dr. Kidner advocates and with which I agree. The condition which we have been calling osteoarthritis deformans juvenilis is the terminal phase of this disease. I have a number of such cases that I have been able to trace.

Then we have the purely mechanical cases, which some of our French colleagues would have us believe were congenital subluxations of the hip. That, to their mind, is the explanation of all. To me, aside from the fact that the infectious theory has some exceptional aspects, such as Dr. Phemister has shown, or such as are to be found in Dr. Kidner's cases, very few cases must furnish the occasion for opening the joint. I believe we may learn or should try to explain this condition, interesting as it is, by an ever so careful study of ever so many x-ray plates. We should study the sections if we are able to get them. I think we should endeavor to get more information on our cases. This is a peculiar condition which has a certain similitude to other obscure conditions. It is similar to Koehler's disease of the scaphoid. It has a certain similarity to what I have described under the title of infraction of the second metatarsal bone, which has now been described by others. It is a peculiar condition, which begins at a certain time, goes through a certain evolution and then stops. We may search in vain for certain anomalies of structure to explain this condition. The factors producing the condition may be trauma in one case and infection in another. It may be that neither of these is required, but simply an abnormal state of local mechanics, such as our honored guest has shown us this morning. Nevertheless, it is a most seductive subject for study and one in which we are going to learn more as the years go by. I think we will learn more if we study it from a broad point of view and not from a narrow standpoint.

Dr. F. R. Ober, Boston: Dr. Legg asked me to show a few of his slides of flat heads, and the first one is the end-result in a case which he saw in 1910. (Slides.)

Dr. Legg still believes in the traumatic theory and sees no adequate reason for changing his views. In no case has there been a white blood count of over 12,000, and in 30 examinations we have had negative Wassermanns. On physical examination we have never seen the symptoms one would expect in

acute infection. There is very little pain in proportion to the amount of disability on passive motion. Abduction is markedly limited. Sometimes internal rotation at a right angle cannot be obtained. We have never seen in any of these cases any marked lighting up of symptoms or any stormy symptoms during the whole period of the disease.

I would like to ask Dr. Jansen first, if the condition be due to an ischium varum of congenital origin, why does not the flattening occur early instead of at varying ages?

Second, has Dr. Jansen any explanation to offer concerning cystic formation, occurring in these heads after the flattening has become well established?

Third, why does the lower portion of the head, where weightbearing is at a minimum, flatten as much as the upper portion, where weightbearing is at a maximum?

Fourth, if ischium varum is to be used as a working hypothesis, should we not find out how often it occurs in normal individuals?

We have all seen x-rays of tuberculous hips which show ischium varum, and it is my belief that it is due to a tilting of the pelvis on the plate brought about by atrophy of the gluteal muscles, present in chronic hip conditions.

Dr. F. C. Kidner, Detroit, Michigan: It seems to me that this condition, as Dr. Freiberg has stated, must be looked upon much more broadly than we have been doing in the past. I do not believe that the set of symptoms which we have learned to know as Legg's disease or Perthes' disease is due to any single causative factor. Dr. Jansen has just given us a new cause which may produce the same anatomical changes as occur in Legg's disease. I still believe with Dr. Phemister that most of the cases are infectious. Some are in the epiphysis and some outside the epiphysis. I have recently had occasion to operate on three such cases, not to find out what was inside, but because the patients had acute symptoms for a period longer than usual, and I did not feel justified in letting them alone. One of them had the typical vacuoles just outside the line of growth between the epiphysis and the neck. One had what I thought to be an acute osteomyelitic cavity of the Brodie type farther out in the neck. He also had a true fragmentation of the epiphysis. All three were negative on culture, and all three provided granular masses of bone which on microscopic examination were said by the pathologists to be infectious in origin, though they were not willing to give any idea of the origin of the infection. I have not the material of these three cases with me because they are still under observation. All three are now being treated by fixation. Coxa plana or Legg's disease is, then, a process which leads to softening and flattening of the femoral head and neck in children. The cause of this process may be any one of many things, such as trauma, infection, or nutritional disturbance.

Dr. R. B. Osgood, Boston: Just to add to the interest of the subject, I wish to report a recent case from the Massachusetts General Clinic, a boy of 16 years, with the typical appearance of this symptom-complex, a little older than usual, and with the symptoms of comparatively short duration. Because of the infectious theory of Dr. Phemister and Dr. Kidner, and the probability that it existed here, Dr. Smith-Petersen investigated. We were unable positively to rule it out, but there were no signs of infection present. Because of the possibility of arthritis deformans or hypertrophic arthritis, as an end-result of all these cases, as Dr. Freiberg has pointed out, and as has been suggested by Dr. Ober's slides, we considered it advisable to explore the hip. Although the x-ray showed the typical picture of Legg's disease, when Dr. Smith-Petersen explored the hip-joint with as good an exposure as his incision gives, it was impossible to say there was a single abnormality of appearance. There was a good round head without flattening. A small section was taken out from the epiphyseal line, and that fragment has been examined very carefully by Dr. James Homer Wright. The cultures were negative. All we can get Dr. Wright to say is that it shows no signs of chronic inflammation and no signs of tuberculosis. There is a very definite change of nutrition. There is a nutritional change in the section of bone taken out. I think the position taken by Drs. Freiberg and Kidner is one we should all take, that there may be multiple causes of this symptom-complex.

Dr. B. H. Whitbeck, New York City: Just one question. In the discussion of Dr. Denucé's method of reduction of congenital dislocation it was brought out that in the Lorenz method a number of cases had developed the condition of coxa plana. It was thought that this was due to the violent manipulations of the surgeon. I would like to ask Dr. Jansen what is his opinion as to the cause of this coxa plana following reduction, whether it is due to reduction or to abnormal anatomic conditions under which the child had to walk.

Dr. Jansen (closing the discussion): It is not difficult in medicine to mix up various conditions. It is more difficult to segregate them and trace the processes separately. You have seen on the slides that flattened socket is present in all my cases of coxa plana. So there is a mechanical factor in the production of the condition. Suppose there is as well a bacterial factor. Even then the accurate study of the mechanical factor would be essential in order to determine for what part the microbes come in. Without such discrimination the solution of the problem seems much more difficult, if not impossible.

It has been asked: "Why does not the flattening of the head occur earlier in life?" The flattening of the head proceeds as the widening of the head develops, and fragmentation occurs only after the widening of the neck has come about. It takes some time for the neck to widen out. Therefore we need not be surprised that the flattening does not occur earlier. At all events the fact that the development of coxa plana is so intimately connected with the second five years of life seems to plead against the bacterial hypothesis, since bacteria are less bound to age.

On the occurrence of cysts in the long bones, we had a very interesting paper yesterday, and the suggestion was made that traumata might sometimes be made responsible for them. The translucent area which is often seen below the growth-disc in coxa plana may be of the same nature as the translucent spots which the socket-roof often reveals. They may indicate the spots

where excess of weight-bearing has led to the most obvious absorption of lime-salts. However, since their traumatic origin is not excluded, they do not plead against the mechanical theory of coxa plana.

Why flattening of the lower portion of the head occurs as well as in the upper part? It must be assumed that the upper portion of the socket, together with the limbus cartilaginus, bears weight on the head. I have always found socket and head to run practically parallel in their upper portion. So this, as all I know of coxa plana, confirms my view that *flattened head is caused by flattened socket.*

# RESULTS OF TENDON TRANSPLANTATION FOR INTRINSIC HAND PARALYSIS. (NEY'S OPERATION.)*

BY J. G. JOHNSTONE, LONDON.

In my short experience of peripheral nerve injuries, particularly of the median and ulnar, I have been very much impressed by the poor functional result after suture where there has been a combined lesion. This is entirely due to the want of return of voluntary power in the hand intrinsics, especially the thumb intrinsics. The percentage of recovery of the intrinsics is about 7 per cent. to 9 per cent. Time and experience have shown that the most that one can hope for after a median and ulnar suture in a combined lesion is a very fair return of useful sensation in the areas supplied by these nerves plus the return of voluntary power in most of the extrinsic muscles of the limb. This leaves the patient with a very crippling disability,—*viz.*, the failure of being able to appose the thumb to the other fingers, especially to the index finger. The average result of a median and ulnar lesion twelve to eighteen months after suture is the typical simian hand,—the fingers extended at the metacarpo-phalangeal joints, the thumb extended at the metacarpo-phalangeal joint and lying in the same plane as the palm of the hand. Where only one of these nerves is injured the picture is somewhat different and the resultant disability is not so great.

There are several causes operating against the recovery of voluntary power in the hand intrinsics, namely:

1. The location of these muscles.
2. The time taken for the regenerating motor neuraxones to reach the motor end plates in these muscles.
3. The small caliber of these muscles, which readily waste and fibrose so that when the young neuraxones arrive there is very little muscle fiber left to function.
4. The difficulty of posturizing these muscles; namely, the lumbricales relaxed by right angle flexion at the metacarpo-phalangeal joints and the thumb apposed into the palm of the hand.
5. The dangers of producing joint stiffness in the fingers by the necessary prolonged immobilization.

*Read before the British Orthopaedic Association, October 20, 1922.

How can these difficulties be overcome and combated by the means at our disposal? To take them *seriatim:*

1. The location of these muscles obviously cannot be altered.

2. The regeneration time, twelve to eighteen months after suture, depending on the site of the lesion, cannot be reduced by the present recognized methods of treatment.

3. There are no methods known by which one can prevent these intrinsics wasting and becoming mere fibrous cords.

4. The retention of these muscles in a state of relaxation favorable to the return of voluntary power is a very real difficulty. A satisfactory splint is very difficult to make, and irksome both to apply and wear, as it requires careful daily fitting. A plaster of Paris splint, to be made comfortable for the patient and at the same time to act efficiently, requires accurate fitting and constant renewal. Indeed, I think that the time and money spent by both surgeon and patient on these articles will be poorly rewarded. The posturization of the hand intrinsics has proved of doubtful value in assisting their recovery.

5. The risk of production of joint stiffness. No amount of daily massage and mobilization of the several joints of the fingers and hand is going to prevent the occurrence of joint changes during the course of twelve to eighteen months waiting for voluntary power to return. If one decides to adopt splintage in these cases I believe it is a wise precaution in cases of median and ulnar paralysis to keep the hand periodically free of all splints except in those where flexor contracture is tending to, or has already, developed.

Consequently, although one has seen very extensive muscle recovery in these cases of median and ulnar paralysis, the functional result is not good, because the apposing action of the thumb has not returned. One is therefore driven to seek other methods than the above to improve the patient's condition. In my search for this I came across an article by Winfield Ney,* New York, in which he advocates the transplantation of the extensor brevis pollicis into the flexor carpi radialis or the palmaris longus. Ney advises this procedure not only as a permanent tendon transplantation but also as a method of posturization of the opponens, in the hope that this muscle will in due course return to voluntary power after a period of relaxation. This latter method I have not adopted because the cases I have seen have been so long after the date of the original injury that the hope of recovery in the opponens was remote.

*Surg., Gyn. and Obstet., October, 1921.

I have had an opportunity of doing only two such operations myself. In both these cases I have used the tendon of the flexor carpi radialis in preference to the palmaris longus, which latter muscle Ney prefers, presumably because thereby he does not diminish the patient's power of wrist flexion. I have used the flexor carpi radialis because the palmaris longus was such a deficient muscle in both cases. Also I have not followed Ney's recommendation to anchor the tendon of the extensor brevis pollicis to the uncut flexor carpi radialis tendon, because I could not see that the resulting simultaneous action of flexion of the wrist and apposition of the thumb was going to be easy to perform or useful to the man. Even in the normal hand these two actions attempted simultaneously are difficult. To appose the thumb one can do it most easily with the wrist held in extension or in the mid-position between flexion and extension. I cut the tendon of the flexor carpi radialis from its insertion so that its ultimate action would be that of apposition of the thumb.

The technic and delicacy of handling the tendons are those which are common to all tendon transplantation operations, so that I need not spend time in dealing with these.

*Operation.*—I. An incision is made along the line of the tendon of the extensor brevis pollicis about three inches long. The tendon is demonstrated lying on the dorsal side of the extensor ossis metacarpi pollicis and in close relation to it. The tendon is cut at its proximal end and carefully dissected distally after opening its sheath as far as within two cms. of the metacarpo-phalangeal joint of the thumb. At this stage of the operation it is well gently to grasp the proximal end of the cut tendon to test its action, as occasionally this tendon at the site of the metacarpo-phalangeal joint is adherent to the tendon of the extensor longus pollicis and aids in extension of the terminal phalanx. If this is found to be the case then one must free these two tendons to prevent this action taking place after transplantation. The tendon to be transplanted must act only on the metacarpo-phalangeal joint of the thumb. The tendon is now wrapped in gauze dipped in saline, and laid aside.

II. An incision is now made three inches long over the tendon of the flexor carpi radialis at the wrist joint, half of the incision running into the palm and half up the arm, the tendon of the flexor carpi radialis is found and freed until it runs under the annular ligament, which is incised for half its breadth. The tendon is cut from its insertion. A tendon transplanting forceps is now run from the distal end of the palmar incision under the annular ligament subcutaneously over the

thenar eminence to the distal end of the thumb incision. Next, the proximal end of the cut extensor brevis pollicis tendon is grasped and pulled through to the palm. Another forceps is inserted into the channel previously occupied by the tendon of the flexor carpi radialis to the point to which one has drawn the tendon of the extensor brevis pollicis in the palm; this tendon is again gently grasped and pulled through the channel to the wrist. With the thumb held in apposition by an assistant it is now sutured to the flexor carpi radialis end-to-end. The thumb and wrist are put in plaster, the thumb fully apposed, and the wrist held in slight flexion to relax tension on the sutures during healing and organization.

The after-treatment is similar to other tendon transplantations. The patient should in due course be able to pick up small articles by means of the thumb and first finger. He should also be able to write.

FIG. I.—Anterior view, showing palmar incision.

FIG. II.—Lateral view, showing thumb incision. Compare range of opponens action with below.

REPORT OF CASES.

CASE 1. G. S. W. Right shoulder, September 1, 1918. Brachial plexus lesion of median and ulnar nerves. Suture in 1919; re-explored 1920. Followed by recovery of all long muscles, but all the intrinsics remained paralyzed. I operated March 6, 1922, transplanting the extensor brevis pollicis to the flexor carpi radialis as above described (note the latter muscle has been once paralyzed). Patient can now approximate the thumb to the tips of the index and medius. He can write in the ordinary way. He can pick up small objects, such as a penny or a sixpence. His only difficulty now is that he cannot appose the pads of his fingers easily, the contact being made with the tips of the fingers. (See Figs I, II, III, IV.)

FIG. III.—Lateral view, showing apposing action of thumb after operation.

FIG. IV.—Anterior view, showing amount of apposition.

CASE No. 1.—G. S. W. Right shoulder, brachial plexus injury, median and ulnar paralysis. Brachial plexus explored twice, suture and freeing. Recovery of all long flexors; recovery of median sensation; recovery of ulnar sensation. No hand intrinsics. Thumb held hyperextended; thumb held adducted. Transplantation done March 6, 1922. Can now pick up articles with thumb and fingers. Can write with difficulty, but distinctly.

CASE 2. G. S. W. Right wrist, October, 1918. Median and ulnar intrinsic paralysis. Suture April 12, 1920. No improvement in voluntary power but good return of sensation. I operated July 10, 1922, transplanting extensor brevis pollicis into flexor carpi radialis in the manner above described. This patient got an excellent result, being able to appose the thumb to the index, medius, and annulus. He writes very well in the usual way; he can pick up small articles; he can button his clothes with the right hand.

# THE TREATMENT OF THE FLAIL ANKLE; PAN-ASTRAGALOID ARTHRODESIS.*

BY ARTHUR STEINDLER, M.D., F.A.C.S., IOWA CITY, IA.

A NEW operative method of stabilizing the flail ankle joint is a rather hazardous thing to submit to you at a time when the excellent methods of Whitman and Davis have only recently been investigated by the Committee on Stabilization of the Ankle and have been recommended as methods of choice. The writer feels, however, that the question of operative ankylosis of this joint is not yet definitely settled, especially as regards the degree and extent of the ankylosis.

The methods of partial arthrodesis of this joint are represented mainly by Dr. G. G. Davis in his subastragaloid horizontal section with backward displacement of the foot, by which method a complete arthrodesis of the joints below the astragalus is accomplished.

The operation of Dr. Michael Hoke is a subastragaloid arthrodesis with temporary removal and reshaping of the head and neck of the astragalus, a method which has been recently described and demonstrated. A partial arthrodesis is also the method of Soule by which a fusion is created between the astragalus and the scaphoid. The complete arthrodesis is represented foremost by the method of Whitman, which is an astragalectomy with backward displacement of the foot and which results in a fibrous arthrodesis in the articulation between the mortise of the tibia and the os calcis.

A complete method of arthrodesis is that described by Dr. J. E. Goldthwait. This method consists in denudation of all joints, both supra- and infra-astragaloid, with the exception of the astragalo-scaphoid joint.

A complete arthrodesis of the ankle joint is also represented by the method of Sir Robert Jones who, in his two-step operation, arthrodeses all the joints above and below the astragalus.

The preference of subastragaloid methods for stabilization of the ankle as represented by the technique of Davis, Ryerson, and Hoke, is based on the proposition that the lateral stability of the ankle is entirely a function of the subastragaloid joint. This is no doubt true for the normal joint. In the paralytic flail ankle, however, it is by no means certain that lateral motion is carried by the subastragaloid joints alone.

*Read at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

Dr. De Forest Willard, in describing a case of subastragaloid arthrodesis, mentions a recurrence of the lateral deformity, which took place, however, not by a relapse in the arthrodesed joints, but by rotation taking place in the ankle joint proper. (*Journal Orthopaedic Surgery*, 1916, 14, 327.)

Baisch, in speaking of the normal foot, mentions that in plantar flexion, the mortise of the malleoli grasps the astragalus less snugly than in dorsiflexion and that, therefore, slight lateral motion in this joint is possible. (*Zeit. Orth. Chir.*, 1913, 31, 221.)

Nové-Josserand insists in flail ankle upon the arthrodesis of the tibio-tarsal as well as the subastragaloid joint. Barbarin prefers the combination of tibio-tarsal and subastragaloid arthrodesis to the medio-tarsal and subastragaloid arthrodesis alone. Ombrédanne also prefers in dangle feet the so-called triple arthrodesis, namely, the tibio-tarsal, subastragaloid, and mid-tarsal fusion, while in the cavus deformity tarsectomy is preferred.

The method used by the writer is essentially a modification of the technique devised by Goldthwait, but with the extension of the fusion to all joints of the ankle excepting the articulation between the cuboid and the calcaneum. The cases which have been largely selected for the use of this method were those of drop and drop dangle foot. Most of the cases of the cavus and calcaneo-cavus deformity were reserved for Whitman's operation. The cases demonstrated will show, I believe, that the resulting arthrodesis is equal in stability to that obtained by other methods, and in addition to this it may be argued that the method described is not mutilating and that it is extremely simple in execution.

## TECHNIQUE.

A U-shaped incision is made around the outer malleolus, beginning two inches above and behind the tip of the fibula and curving downward and forward, similar to the incision used in Whitman's operation. After division of the peronei and the calcaneo-fibular ligament, the joint is opened by extreme supination and adduction of the foot. The joint surfaces of tibia and fibula, as well as of the body of the astragalus, are now in view. All cartilage is painstakingly removed until nothing but raw cancellous bone is in evidence in place of the cartilage. By pulling the body of the astragalus upward the subastragaloid joint is then brought into view and this, too, is completely denuded of its car-

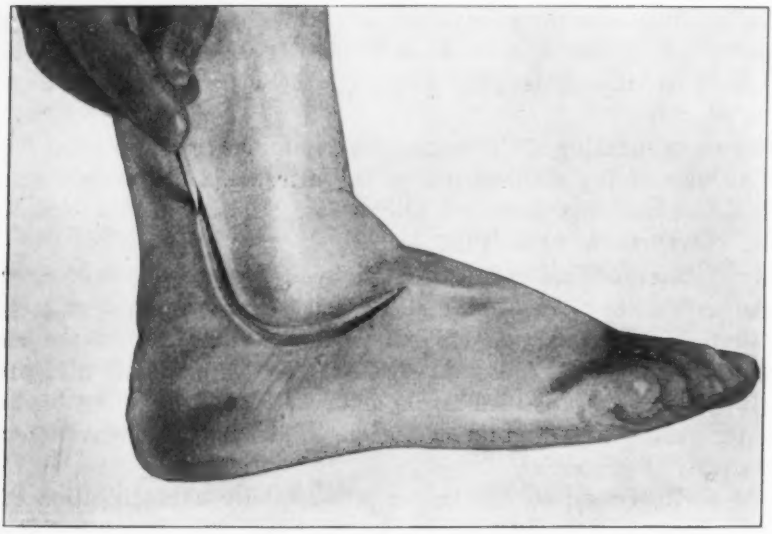


PLATE I.—Incision circling outer malleolus.

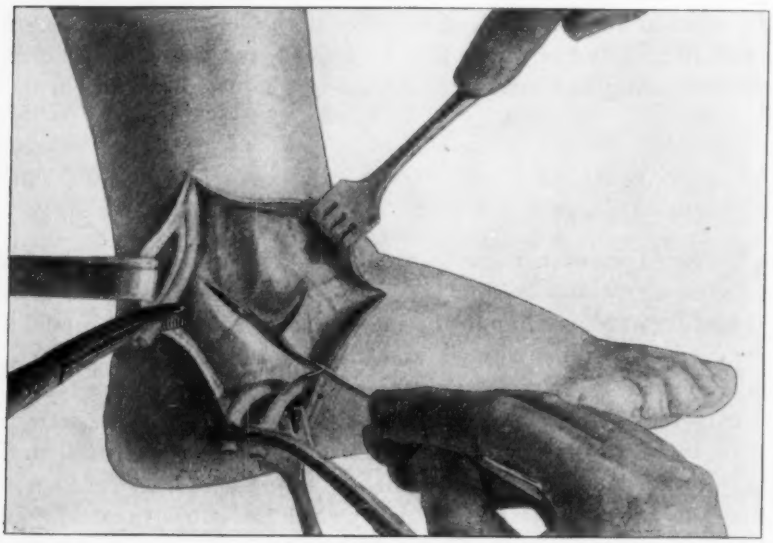


PLATE II.—Cutting peronei and deltoid ligament.

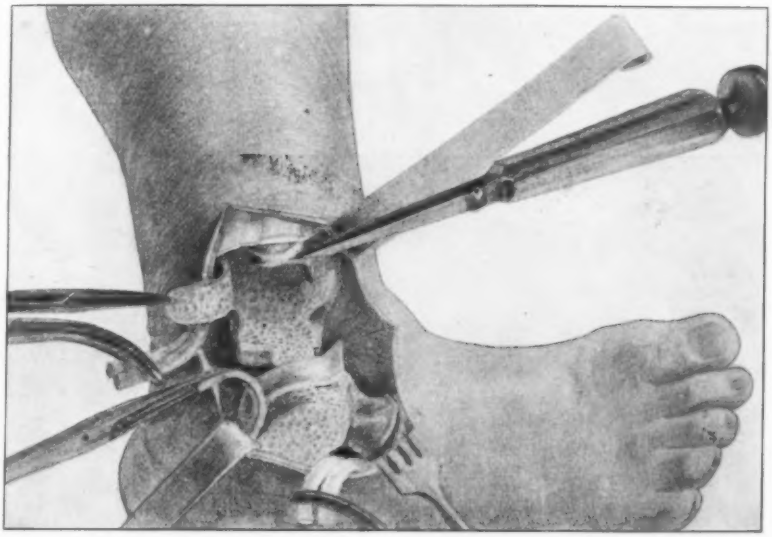


PLATE III.—Denuding articular surfaces of tibia, fibula, and upper surface of astragalus.

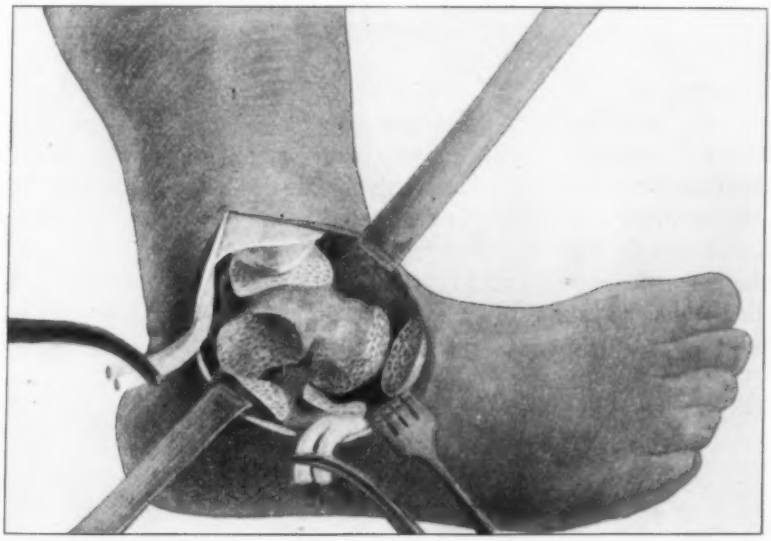


PLATE IV.—Denuding articular surfaces between astragalus, os calcis, and scaphoid (subastragaloid joints).

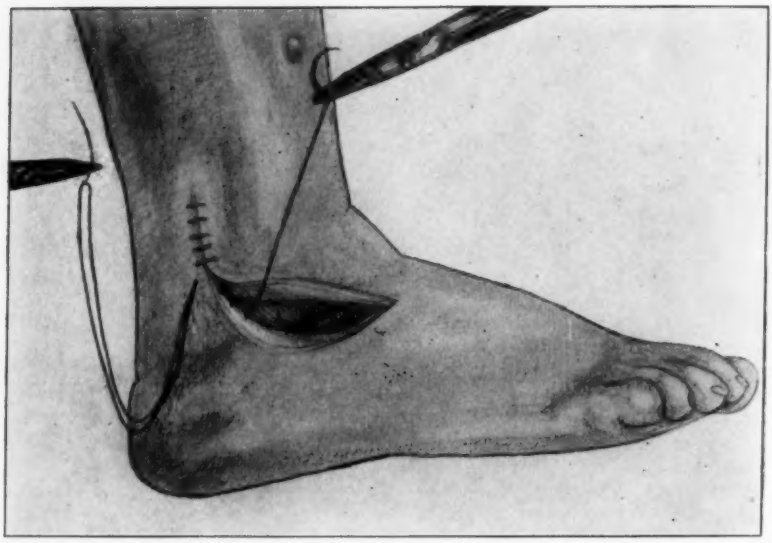


PLATE V.—Closure by layers.

tilage covering. Lastly, after division of the astragalo-scaphoid ligaments, the joint between the latter two bones is opened and likewise completely denuded of its cartilage covering. In this whole maneuver the astragalus remains attached only by its inferior ligaments. When the denudation of cartilage is completed in all joints, the astragalus is replaced and the foot is put up again in normal position. The cut ends of the peronei are reunited and the wound is closed in layers. A small gutta percha drain may be left for 24 hours to take care of the oozing. (Plates I-V.)

## POSITION.

We have found that the most suitable position of the foot following operation is that of perfect lateral alignment with about twenty de-

FIG. I a.
Paralytic equino-valgus.

FIG. I b.
One and one-half years after arthrodesis.

FIG. II a.
Paralytic drop dangle foot.

FIG. II b.
Nine months after arthrodesis.

FIG. III a.
Paralytic equino-varus.

FIG. III b
Two and one-half years after arthrodesis.

FIG. IV a.
Paralytic drop dangle foot.

FIG. IV b.
One year after arthrodesis.

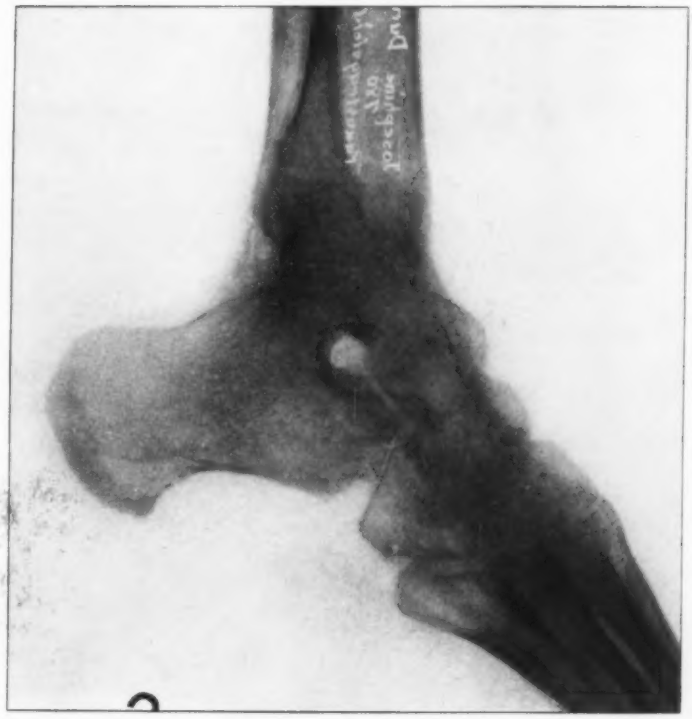


FIG. V.—Forty years; fusion six months after panastragaloid arthrodesis.

grees of drop corresponding to ¾ to 1 inch plantar flexion. A greater drop of the foot is not so well tolerated, even if it might seem advisable to equalize the shortening of the limb.

A plaster of paris cast applied in the position described, extending over the slightly flexed knee, remains in place from three to five months, after which time it is replaced by an ordinary strong boot.

*A flail foot, not deformed, associated with a good knee or at least good or fair knee flexors,* is best suited for this method.

## RESULTS.

The ankylosis obtained by this method is thorough and solid and x-ray pictures show complete fusion of the joints in a large majority of cases. The gait is firm and with few exceptions, painless. The condition of

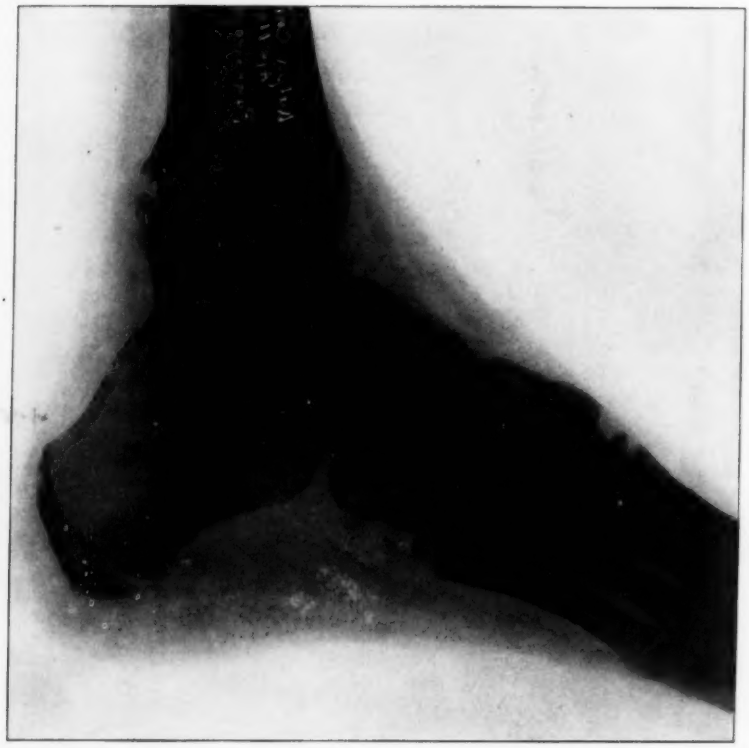


FIG. VI.—(Same case as Fig. 4.) Fusion six months after panastragaloid arthrodesis.

the knee is of great influence upon the stability of the ankle. The fusion in slight equinus position has a tendency to stabilize the knee. Any residual contraction of the knee must be overcome beforehand. Any disalignment between knee and ankle, such as inward rotation of the patella, should be corrected afterwards. This latter complication calls for an osteotomy of the tibia with outward rotation of the leg above, and this measure has been applied in several cases with material improvement of the gait. (Figs. I-VI.)

REPORT.

Of 36 cases operated upon by this method, 35 were cases of infantile paralysis. The youngest patient was 17 and the oldest 40 years old. Paralysis of the ankle alone existed in 19 cases and paralysis of the ankle combined with that of knee or knee and hip, in 16 cases.

The duration of the paralysis ranged between 1½ and 39 years. The types of residual deformity were distributed as follows:

Paralytic drop dangle foot, 19 cases; paralytic equino-valgus, 6; paralytic calcaneo-valgus, 3; paralytic equino-cavus, 2; paralytic equino-varus, 5.

### END-RESULTS.

Twenty-one of the cases operated upon have been under observation one year or more following operation. Four cases showed no pre-operative shortening, while in the remainder of the cases there was a pre-operative shortening ranging from one-eighth of an inch to two and three-quarters of an inch. An ankylosis of the joint sufficiently firm was obtained in practically all cases. Of four cases wearing braces before operation, one discarded the brace, while the other three retained it. All of the three cases wore braces, however, for deficiencies of the knee.

Eighteen cases walked after operation with the foot in corrected position and without brace. In two cases, the osteotomy of the tibia was added later in order to procure a proper alignment of ankle and knee.

The author feels justified in recommending this method for the stabilization of the ankle joint in cases of drop foot or drop dangle foot.

### DISCUSSION OF DR. STEINDLER'S PAPER.

Dr. Michael Hoke: I appreciate Dr. Steindler's paper. Dr. Steindler is correct, I think, in stating that sub-astragaloid arthrodesis, no matter what may be the method employed, does not solve the problem of the dangle foot. The reason is that even if one stabilizes the sub-astragaloid joint, universal joint motion still remains in the ankle joint. In the dangle foot the internal and external malleoli are usually not normally developed, and do not grip the body of the astragalus sufficiently firmly to prevent lateral motion.

In the moving pictures we have seen, the patients seem to walk very well. I think we still have to decide between astragalectomy and pan-arthrodesis for dangle foot. Of course, the ideal result to obtain in dangle foot is a foot that is stable in so far as lateral motion is concerned, and yet possesses a little plantar and dorsal flexion movement. Astragalectomy would give this combination. I have not seen Dr. Steindler's cases. One of the difficulties about a medical meeting is that we are called upon to discuss things we have not examined, and impressions may be recorded that are totally erroneous because not formed from observation. I would not like to state, therefore, which is preferable—astragalectomy or pan-arthrodesis. I hope to have the opportunity of seeing some of Dr. Steindler's cases later, so that I may be able to obtain a correct comparative opinion as to which is the better operation for dangle foot.

Dr. A. Bruce Gill: Dr. Steindler's discussion of arthrodesis of the foot, together with the report of the Commission on stabilization of the foot, tends,

I fear, to confuse in the minds of many this subject of stabilization of the lower extremity. The entire matter is after all very simple.

Lateral deformity of the foot is best corrected by arthrodesis of the joint in which lateral motion of the foot takes place, *i.e.*, in the subastragalar joint. By subastragalar joint we mean the articulation of the astragalus with the os calcis beneath and the scaphoid in front, which constitutes one joint. The foot rotates about the astragalus which is fixed between the malleoli. Davis' subastragalar arthrodesis or Hoch's method of stabilization both accomplish this result. A firm and permanent arthrodesis may always be secured after the age of seven or eight years, if the operation is done properly.

If there is marked lateral unbalance of muscles, lateral play may develop in the ankle joint after a subastragalar arthrodesis. It is wise, therefore, to attempt an approximate balancing of muscle power at the same time that the arthrodesis is done.

If there is a dangle foot, *i.e.*, without power below the knee, combined with power above the knee, again the problem is simple. Stabilize the dangle foot by a Davis horizontal transverse section or by a Whitman astragalectomy. Both methods, if properly done, are absolutely efficient.

If there is a dangle foot combined with no power above the knee, *i.e.*, a flail extremity, the problem becomes more difficult. If there is power in the glutei the patient will walk quite well if we secure stability of the foot as advised above, and in addition correct contraction deformity at the knee so that the knee may slightly hyperextend when weight is put upon the foot. In young patients this hyperextension may be secured by tenotomy of the hamstrings or by forcible hyperextension under an anesthetic; in older patients or even in younger ones in whom relapse occurs, an osteotomy of the femur above the knee is necessary to secure a permanent back-knee. So often contracture of the knee is combined with a knock-knee. Osteotomy is then indicated. If there is no power in the glutei, the case is still more difficult, but the patient may be enabled to walk without a brace if we arthrodese the ankle with the foot dropped about 15 degrees below the right angle, and at the same time make a back-knee. Years ago Dr. Davis pointed out the mechanical action thus secured to stabilize the flail extremity. If in this latter condition there is lateral deformity of the foot, a subastragalar arthrodesis is to be combined with the ankle arthrodesis, and Dr. Davis did this combined arthrodesis simultaneously or at different operations, as the occasion demanded, in numerous instances.

Therefore, I think it is unwise to introduce an operation called the panastragalar arthrodesis, which includes arthrodesis of ankle and subastragalar joints. The indication for each of these arthrodeses is clear and definite, and the one is not related to the other. For certain conditions we do subastragalar arthrodesis, for another condition we do ankle arthrodesis. In a few instances we combine the two, as mentioned above. Is it not better not to confuse the entire matter by proposing an operation which in the first place is only a combination of two arthrodeses long since described and in use for many years, and which in the second place does not take into account the clear-cut simple principles enumerated above?

# ELECTRICAL TREATMENT OF INFANTILE PARALYSIS AND OTHER LOWER NEURONE LESIONS.*

BY G. MURRAY LEVICK,

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Occasionally the efficacy of electrical treatment of the muscles affected by anterior poliomyelitis comes under discussion, and from what has been said both by its advocates and opponents, it appears rather as if the most important factor has escaped notice.

The actual nutrition of the muscles during their paretic period appears to be the only matter considered. Connected with this, however, is another consideration of such importance that it should be placed first of all, as it is the crux of the whole question, of which the neglect causes many of the tragic results following quite mild attacks of this disease.

This factor is the preservation of contractility in the muscles. It has been asserted that muscles cut off from their motor nerve supply may be seen to waste, even if they receive electrical treatment, but if this is properly applied, the wasting, which should be slight only, is not accompanied by loss of contractility. If no such electrical treatment is given, the atrophy is greater and is usually accompanied by loss of contractility in some degree; sometimes by entire loss, so that no electrical response can be obtained.

This can be explained by the accepted theory of muscle contraction given to us by Schaffer. When a muscle contracts, the clear contractile substance passes into the tubes of the sarcous element, which are elastic and are dilated by its entry. When the muscle is relaxed, this substance flows out of and remains outside the sarcous element, the little tubes narrowing as they elongate.

So long as the muscle remains in a state of complete relaxation, for example, when elongated during paralysis, the little tubes remain in this posture. It appears to me that the atrophy following the paralysis, besides causing absorption of the contractile substance, is accompanied by a loss of elasticity in the sarcous element, so that the tubules can no longer dilate to their proper extent for the contraction of the muscle

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in response to a stimulus. This loss of elasticity may be partial, leading to an impairment of contractility in the muscle, or if allowed to progress far enough, such rigidity is the result that dilatation is impossible and contractility is altogether lost.

The above theory is absolutely in accordance with observed facts, and it will be seen that it is a separate condition apart from the mere loss of contractile substance.

In lesions of the lower neurone these changes take place more rapidly in young children than in older children and adults, so in their case it is very needful to begin early. But in any case there is really only one way absolutely to safeguard these paralyzed muscles from this dire catastrophe, and that is to ensure a periodical contraction during paralysis, and the only way to ensure this is to employ electrical stimulation. There are no other means.

The cause of failure of electrical treatment in infantile paralysis lies too commonly in ineffective methods of application, and this leads to erroneous opinions held on the subject by those who observe the results. Treatment directed to an increase of the circulation in the affected limb yields good results up to a certain point, and undoubtedly improvement of nutrition in the limb as a whole takes place when, for instance, it is periodically immersed in a faradic or sinusoidal bath, but to show the futility of such treatment in maintaining the contractility of the paretic muscles, only one typical case need be cited.

Suppose a patient to be suffering from acute anterior poliomyelitis in the following degree. Extensor longus digitorum and extensor proprius hallucis do not respond to faradism; tibialis anticus responds very feebly, while the peronei are quite normal. The interrupted faradic or sinusoidal current is now passed through the whole limb. The muscles that most need the treatment are extensor longus digitorum and extensor proprius hallucis, and these do not respond at all. Next in order of importance comes tibialis anticus, which responds only feebly, while the peronei, which are normal and do not need the treatment, respond quite well. At the same time actual harm is done owing to the action of the peronei and the normal calf muscles which plantar-flex the ankle joint, thus stretching the paretic muscles at each surge of the current. This latter evil can be avoided if the foot is firmly splinted during treatment, but this is a difficult matter when a bath is used, and a precaution rarely carried out.

It has already been stated that wasting and loss of contractility proceed more rapidly in young children than in older patients. This ren-

ders effective treatment the more urgent in their case, especially as the limb will be increasing in length.

Passing to the application of the treatment, it cannot be too strongly urged that paralytic muscles should be treated only by operators who have learned this particular work under proper supervision in a school dominated by orthopaedic ideas. A masseuse who has passed an examination in electrology, etc., on experience gained on normal muscles or in the performance of the more usual forms of medical treatment is not ready to undertake this work. It is often a very difficult matter to pick out and exercise wasted paretic muscles, and success in the more difficult cases can be attained only by constant practice on the particular type to be treated.

A good example is that of the trapezius, paralyzed after injury to the spinal accessory nerve in an operation on glands in the neck. A case of this sort may be sent for treatment say a year after the lesion occurred. The nerve is recovering, the muscle is wasted, the lower fibers not activating. The rhomboids and levator anguli scapulae respond whenever the current leaks into them or the fifth cervical nerve during the efforts of the operator to pick up the paralyzed muscle. I believe there are very few operators who know how to coax this paretic trapezius back to the stage where voluntary exercise can be begun. Only a clever hand, practised in the treatment of this particular lesion, is likely to succeed. On the other hand, the incompetent will only increase the hypertrophy of the normal muscles mentioned, and the treatment thus proves a failure time after time.

Turning to another type of patient, I will record a case I had not very long ago, because it is so very instructive. A boy of sixteen was sent to me who had suffered from facial paralysis on one side since the age of five, the history being typical of an ordinary "Bell's palsy." When I first saw him he had slight voluntary control of his frontalis, corrugator supercilii and levator labii superioris. There was a faradic response in these but in no other facial muscles. They were so ill developed that the galvanic response was small, but clearly normal in character. It seemed evident that the lower neurone disturbance from which he had suffered originally had cleared up completely long ago, but the recovery of the nerve had never been discovered.

After a little treatment with the galvanic current, a faradic response was obtained throughout the facial muscles, and gradually day by day the muscles were exercised and redeveloped by means of this current. All attempt at voluntary movement was forbidden at first, as it only

elicited response on the opposite side, but as soon as a fair state of nutrition had been obtained in the treated muscles, exercises were begun by the patient, who was taught to "make faces" in a mirror, endeavoring to get even movement on both sides. The result was a great success. The normal creases began to appear and the boy could smile without evident distortion. The muscle presenting the greatest difficulty was orbicularis palpebrarum. He had suffered from conjunctivitis for years, owing to his eye remaining open during sleep, but even this symptom disappeared in the end.

I have come across a good many cases of infantile paralysis in which nerve recovery had been undiscovered because electrical treatment had not been sought from those competent to give it, and diminution of nutrition and contractility in the early stages of the disease had prevented recovery of tone later on. In the case of facial paralysis described above, an important factor was that the paralyzed muscles had not been greatly stretched.

It is hardly necessary to say that the relaxation of paralyzed muscles, if needful by artificial posturing, is of primary importance; far more important even than electrical treatment, because a paralyzed muscle cannot recover if kept on the stretch.

If electrical treatment cannot be obtained, the relaxation by posture should be continuous until voluntary movement has returned. The success of the treatment of paretic muscles by continued relaxation is, I think, due to the fact that little by little, as the tonic stimuli return through the recovering axons, the contractile substance is able to wedge its way back into the tubules of the sarcous elements.

This must necessarily be a slow process owing largely to the weakness of the stimulus, and should the muscle, even momentarily, be stretched, it must take many hours for the lost ground to be regained. When proper electrical treatment is being given, however, not only will the return of tone be far more rapid, but it seems to me that there can be no harm in one daily movement through the complete range of the joint crossed by the muscle, just before the treatment is given, because immediately afterwards the fullest possible contraction of the fibers can be obtained by electrical stimulus. Thus the former objection to the daily stretch is removed and much benefit derived in other directions.

It is hoped that these outlines may induce those who have been skeptical as to the uses of electrical treatment of muscles affected by lower neurone lesions, to give the matter further consideration, as it is surely desirable in all cases, so long as any recovery of the nerve is hoped for.

# A CRITICAL CONSIDERATION OF CONGENITAL RADIO-ULNAR SYNOSTOSIS. WITH SPECIAL REFERENCE TO TREATMENT.

BY ALEXANDER GIBSON, F.R.C.S (ENG.), WINNIPEG, MAN.

THIS condition is not a very common one. It has been dealt with rather exhaustively in German literature, but the records in English and American literature are not very extensive. An admirable paper by Wilkie gives the main particulars. It is impossible to add much to his masterly presentation of the subject. In America, papers by Feidt, Kopelowitz, Painter, and Sever have also appeared. A perusal of the literature brings out clearly the fact that there is as yet no unanimity in regard to treatment of the condition. On the one hand, many surgeons are content to let the condition alone; at the other extreme may be mentioned the patient of Dawson who underwent five or six operations on the one forearm. The purpose of this paper is to discuss the question of surgical interference, and to examine what have been the results of such interference in the past. A short résumé of the subject may be of interest.

Congenital radio-ulnar synostosis has a marked hereditary tendency. Feidt's two cases occurred in mother and daughter. Dawson's occurred in brother and sister, and a maternal grandmother had shown the same peculiarity. It may be unilateral or bilateral. Two types are described, according to whether the fusion is or is not accompanied by dislocation of the head of the radius. In the former type the dislocation may be forward or backward. Most writers regard the condition as congenital, Stimson being doubtful.

In the majority of cases the radius is said to be fixed in full pronation. The inferior radio-ulnar joint is described as free. Shortening and bowing of the forearm usually occurs, and while flexion of the elbow is unimpaired, extension may be slightly limited. Movement at the carpal joints is usually more free than normal, so that a certain amount of rotation of the hand on the forearm is possible.

In regard to the important question of disability it is hardly fair to consider many of the cases occurring in childhood. Many are noticed quite accidentally, *e.g.*, in one of Wilkie's cases, a boy aged 5½, the con-

dition had not been observed until a few months previous. In a case recorded by Painter, a girl of 11 complained of tiring easily when learning to write. Up to this time "neither the child nor the parents had detected anything abnormal."

In older subjects one notices that the disability is not incompatible with earning one's living by hard manual work, as in Feidt's case, where the patient, a female aged 42, noticed especial difficulty in wringing clothes. One of Wilkie's cases, a male aged 34, could earn his living as a laborer although possessing a bilateral synostosis; another, female aged 24, had no difficulty in ironing in a laundry. Her chief disability was in receiving change. In Kopelowitz's case, a male, 22, with bilateral fusion, no mention is made of a similar drawback in his work as a hotel porter. The position of full pronation is quite compatible with piano-playing (Feidt). Lunn's patient worked as a waitress, carrying trays on the back of her hands. From such considerations as these it is obvious that the disability, though a handicap, is by no means an insuperable one.

If operative interference is undertaken it may take place in childhood or in adult life. In favor of early operation is the fact that the younger the patient the more readily will the soft parts adapt themselves to new conditions and to new functions. Against early operation is the equally important fact that the elbow region in children is especially prone to the formation of new bone, and that however thorough the removal of bony bridges, the tendency to recurrence of the synostosis is overwhelming. Practically every case operated on in childhood has shown recurrence. Stretton in 1899 removed about one inch of the upper end of the radius, leaving only sufficient attachment for the biceps tendon. The case was not seen again until 1905, when the condition was "practically the same as before operation." Rais after division of the synostosis found the result "disappointing." Jackson Clarke's experience was that "synostosis recurred." Roth, in 1921, reported a case of operation on a boy aged 10. Discussion of this case elicited the general opinion that "no movement at the radio-ulnar joint was possible." Sever performed an osteotomy of both radii in a case of bilateral fusion, putting the forearm up in full supination, keeping it thus for six weeks, and following with a "very rigid course" of after-treatment. His conclusion, in spite of recurrence of the synostosis on one side, is that both arms were "more useful." The evidence adduced in this case is probably more convincing to the operator than to a stranger. Strenuous passive movement of the elbow region is emphatically contraindicated after injuries in children. Impartial consideration of the reports leads

one definitely to the conclusion that in children removal of the bony bridge with or without resection of the head of the radius is a mistake. Osteotomy of the radius as exemplified in Sever's case does not provoke enthusiastic encomiums. It is suggestive that "long-distance" reports after operation in childhood are not forthcoming, although ample time has elapsed for their appearance.

Is operation worth while in adults? Perhaps no case has had the benefit of more thorough surgical treatment than that recorded by Dawson. The patient, a female aged 33, underwent no fewer than five operations on the one forearm. The bony bridge was first divided; the second operation consisted in "freeing the head of the ulna"; the third operation was "division of the interosseous membrane from top to bottom through a straight incision down the flexor surface of the forearm." When as a fourth measure excision of the head of the radius was performed, "it was found that some slight bony reunion had taken place between the cut surfaces of radius and ulna where the original bridge of bone had been removed." Evidently then recurrence of synostosis is not limited to childhood. Although a considerable measure of improvement had been obtained, the patient was not satisfied and accordingly under a fifth anesthetic there was carried out "osteotomy of the radius through an incision seven inches long" at the junction of middle and lower thirds of the forearm. The fragments were secured by a plate and screws. Presumably a sixth operation would be necessary for removal of the plate. Dawson at the date of writing (1912) thought the result had quite justified the procedure. At a discussion on the subject at the Royal Society of Medicine in March, 1913, the general opinion was that the result was poor compared with the amount of work done. From the esthetic point of view alone the scarring of the forearm must be sufficient to brand this case as at least an incomplete success. It is significant that although the condition in Dawson's patient was bilateral there has been no report of operation on the other arm, although ten years have elapsed; and further that, although a younger brother in the same family has the same disability, there is no report of operation on him.

It should be remembered that in adults the soft parts must be adapted strictly to the position of pronation which has existed since birth. Dawson at operation found "no trace of the supinator brevis muscle." The pronator quadratus muscle is bound to be very much shortened, and all the muscles of the forearm, flexors and extensors, must be strictly accommodated to the bony conditions under which they have worked for years. Further, the cortical representation of the movements of prona-

CASE 1.—D. H.

CASE 2.—A. J. O.

tion and supination must be present in an undeveloped condition, if present at all. Even granting that anatomical conditions were modified to permit of passive pronation and supination, it is far from likely that active movements would be possible until the lapse of considerable time.

Is interference ever justifiable? If it be assumed in any one case that radio-ulnar fixation is inevitable, the next consideration is, "Which is the best position for such fixation?" Full supination is certainly not the optimum position; full pronation is probably not so good as the mid-position. An osteotomy to bring about this change of position from full to semi-pronation is probably justified in some cases. For the most part the patient is not likely to lose much if left alone.

Subjoined are notes of two cases which have come under the writer's care.

D. H. Aged 2, female. Condition noticed about one week ago by a friend. Examination of upper limbs shows a congenital synostosis of right superior radio-ulnar joint. X-ray shows fusion of the head of the radius to the ulna without dislocation. The forearm is definitely shorter; the radius is no stouter than on the opposite side and is definitely bowed. The ulna is slender and is also shorter than the left ulna.

A. J. O. Aged two years and nine months. Mother thinks the left arm is "not right." First noticed about two months ago. X-ray shows congenital synostosis of the bones of the left forearm. Both bones are shorter than on the opposite side. The ulna is definitely more slender while the radius is stouter and more bowed.

In neither case is there a hereditary or family history. In regard to both patients a waiting policy was pursued.

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# BONE BLOCK AT THE HIP JOINT.

BY WALTER TRUSLOW, M.D., F.A.C.S., BROOKLYN.

AMONG the most brilliant achievements of orthopaedic surgery is the detection and elimination of body disabilities due to bone block in joints. As the writer uses the term, bone block is a condition in a joint whereby one or more of the movements normal to that joint are limited solely by the presence of a bony outgrowth at or near the joint. (See Fig. 1.)

FIG. 1.—F. G., chauffeur. May 24, 1921. Old fracture of neck of femur 11 years previous, leaving a traumatic coxa vara with exostosis on upper surface of neck, and limiting abduction (at 12 deg. adduction).

The causes of such adventitious outgrowth are various. Bone block does not include ankylosis or partial ankylosis found in a joint actively inflamed by the lesion of any infection; although the outgrowth of bone

tissue, due to such infection long since healed, may constitute true bone block. Bone block also may result from the faulty union of fractures near or involving a joint.

The presence of the blocking bony excrescence can often be discovered, or at least definitely suspected, by carefully studying the case history and by thorough clinical examination. In the examination, the characteristic feature is actual and complete stopping of the moved segment before the normal range of motion is reached; and the stoppage is in one direction only, or in directions associated each with the other, whilst motions in other directions may be unlimited. Also passive motions are made with little or no pain to the patient. This, of course, differentiates bone block limitations of motion from those found in acute inflammatory conditions; as in the latter, passive motions are more or less limited in all directions and are usually made with pain. The x-ray study usually elicits the presence and the location of a blocking growth, although views in different directions or by stereoscopic exposures may be necessary.

The surgeon may be consulted simply because of disability due to lessened range of motion; but it is more usual that the patient complains of pain. If there is pain, it is found that it is present on using the joint, and ceases, or is greatly lessened, when the joint is at rest. The pain may be due to direct and constant impinging of unduly approximated bony points upon each other, or possibly the buckling in and pinching of soft parts between bones; or it may evince itself as a strain more or less distant from the joint involved and due secondarily to muscles unduly stressed in attempting to accommodate the body to the unbalances caused by the incompleted movements of the blocked joint.

Whatever may be the disability, pain or strain, the patient seeks relief, and the surgeon, skilled in the problems of deranged joint mechanism, must weigh carefully the disabilities and the possibility of mechanical compensation or of operative elimination of the bone block cause, for true bone block does not cure itself, although much compensation for its disabilities may often be attained.

It is because these problems are sometimes difficult and operative results of doubtful benefit, as applied to the hip joint, that the writer presents a brief analysis of two cases of bone block at the hip joint upon which he has operated. When operative treatment is decided upon it is often possible to change the carrying or weight-supporting angle of a long bone, near the joint, in such a manner as completely to compensate for the blocked motion in the joint and a good result is obtained. This,

of course, eliminates the danger of even greater loss of function which may result from entering the joint proper. As exostoses, when found about the hip joint, are usually located at the edge of the femoral head, as in Case I, here presented, or at the rim of the acetabulum, as in Case II, it can be eliminated only by entering the joint. And as bone block at the hip joint does not conform strictly to the definition here set forth, in that some limitation to most of the normal motions is found, an extra-articular osteotomy with determination of a new angle would not meet the requirement of resulting free motions in all directions. The writer questions whether the intra-articular operation, as evidenced by the results obtained in his own cases, warrants the time and expense to the patient, even when the blocking bone was apparently entirely eliminated.

Case I. Old fracture at junction of head and neck of femur resulting in coxa vara, with bone exostosis on the upper margin of the neck of the femur, which by impinging upon the adjacent lip of the acetabulum, resulted in adduction deformity and one inch shortening with much pain.

Chauffeur, 38 years old. At nineteen years of age, fell from and dragged by a sleigh, fracturing the left hip. In bed seven weeks; one year on crutches. Always pain, ever since, on walking. Pain referred to upper outer thigh. On examination, it was found that the upper end of the thigh bone, on the affected side, was very prominent; on walking, upper end of femur moves upward and forward with each step. In prone lying, affected trochanter one-half inch above opposite side. The affected thigh could be flexed 75 degrees, could be over-extended 10 degrees, was prevented from abducting at 10 degrees short of the neutral position, adduction was unlimited and rotation was almost nil. Where limitation of motion, in any of these directions, was reached, it was with practically no pain to the patient, but with a distinct sense of sudden stopping, like that of the normal extension of the elbow. The x-ray (Fig. 1) showed an old healed fracture through the base of the head of the femur with the head displaced downward (or the neck displaced upward)—a traumatic coxa vara—and with a bony outgrowth on the upper margin of the neck of the femur, so placed as to impinge upon the upper rim of the acetabulum, even when the thigh was in adduction.

This was a case of true bone block, distinctly limiting much of the hip motion, and by mechanical disadvantage and by pain, greatly interfer-

ing with the man's work. The only mechanical aid which could be suggested was that of raising the sole and heel to compensate for shortening. He had done this himself; but pain and disability, though lessened, were still a burden to him. He was very willing to consider operation. A Ganz operation with new abduction position of thigh was rejected because motions other than abduction were limited. Intra-articular operation was performed in June, 1921. The U-shaped lateral incision, with approach to the joint by turning back of trochanter major and its muscular insertions was used. It was comparatively easy to chisel off the extra bony mass on the upper border of the neck. Then there was a cuneiform osteotomy of the neck of the femur. After reposition of the trochanter and closure of the wound the limb was put up in plaster of Paris dressings, from the waist to the toes, in abduction.

While in the hospital, on the third day, he managed to tear away the plaster of Paris dressing over the opposite side of the pelvis, and when found the next morning, he had a smile on his face and a complete return to adduction position. Although it was explained to him that it was not improbable that he had thus destroyed the usefulness of the operation, it was not possible inside of three weeks to get consent for the re-application of plaster dressings in abduction position.

All dressings were removed nine weeks after the operation, and the patient was advised to use the part as much as possible. The use of the bicycle aided this.

Examination in April, 1922, ten months after operation, showed:

A limb shortening of 7½ inches—One-half inch increase.
A. G. F., 128 degrees—23 degrees more limitation.

All other motions, especially the disabling limitation to abduction, were increased as follows:

A. G. E., 20 degrees over-extension—10 degrees more motion.
Abduction, 20 degrees—32 degrees more motion.
Adduction, 5 degrees—No change.
In-rotation, 8 degrees—8 degrees more motion.
Out-rotation, 12 degrees—12 degrees more motion.

This gives a total of 39 degrees more motion than before operation, and the patient is now without pain and back at his work as chauffeur. But there is less flexion than before operation, now only 52 degrees, and

one and one-half inch shortening, one-half inch more than before operation. These unhappy results are undoubtedly due to his willfulness in removing part of the plaster and not allowing it to be re-applied until three weeks afterward, thus destroying the angle obtained by osteotomy of the neck of the femur and correction in the abduction position.

FIG. 2.—One year after removal of limiting exostosis. He could then abduct thigh 20 deg. (a gain of 32 deg.).

The last x-ray (April, 1922, Fig. 2) shows clearly the reason for the increased shortening and the lessened flexion. There appears to have been added to the original deformity, subtrochanteric fracture with fixed upward riding of the shaft. The only useful result obtained is due to the complete removal of the exostosis at the neck of the femur. The writer frankly believes the mechanical deformity is but little better than before operation, though the resulting absence of pain may have warranted the operation.

Case II. Old intra-pelvic fracture of the acetabulum, with half-inch

FIG. 3.—Mrs. C. Feb. 28, 1921. Exostosis on lower lip of acetabulum, limiting adduction of thigh (at 10 deg. abduction).

bony protrusion on the lower lip of the acetabulum, preventing adduction by impinging of neck of femur on the elongated acetabular rim; with much pain.

Mrs. C., 55 years of age, of sedentary habits. At ten years of age, fell from a horse, "hitting the knee." Apparent recovery. At seventeen years of age, severe attack of "rheumatism," which affected the hip. It was "burned" a number of times and was much better for two years. Gradually worse since nineteen years of age. Osteopathic treatment seven years ago; some relief at first. None for past year. Now pain on sitting and on getting up. Can walk half a mile, but good for nothing rest of the day. On examination, there was found to be one-half inch apparent shortening, on placing the limbs parallel, but none on placing both in fifteen degrees abduction. There was distinct atrophy of the affected thigh.

FIG. 4.—Mrs. C. One month after removal of limiting bone block. She could then, and a year later, adduct thigh 15 deg. (a gain of 25 deg.).

Hip motions:

A. G. F., 85 degrees (95 degrees flexion); A. G. E., 160 degrees (20 degrees of flexion); abduction, only 18 degrees; adduction limited at 10 degrees of abduction; rotations limited, especially in-rotation.

The first x-ray showed to the observers, including the writer, no sign of the intra-pelvic fracture, but an outward extension of the lower lip of the acetabulum, impinging clear to the middle of the lower border of the neck of the femur, was very evident. Mechanical disability was scarcely noted by the patient; pain was said to be great, perhaps exaggerated.

No mechanical apparatus appeared likely to offer relief. Nor was an extra-articular osteotomy with reangulation of the femur considered adequate to relieve all of the joint motion disabilities. Direct removal of the protruding lower rim of the acetabulum was decided upon.

Operation was performed in March, 1921. Anterior incision; the joint capsule reached by separation between the sartorius and rectus femoris

muscles; section of capsule; although most of the protruding bone had to be removed by finger guiding the chisel, the redundant bone was apparently entirely removed—in two pieces, one, one inch long, and one three-quarters inch long. There was no plaster of Paris fixation of this limb. There was primary union of the wound, and passive motions were begun in one month.

The pain of this was greatly complained of by the patient, who was much depressed in mind. Passive motions were continued, however, and the patient urged to walk and do simple active motions.

After one year (March, 1922) the examination showed no shortening; flexion, 90 degrees—5 degrees better; extension to ten degrees of overextension—30 degrees better; abduction, 18 to 20 degrees—about as before operation; adduction, 15 degrees—25 degrees better; rotations, practically unlimited, whereas there had been much limitation of rotation. The x-ray (Fig. 4) shows complete removal of the blocking bone on the inferior margin of the acetabulum.

There is a decided neurotic element in this patient. Mechanically and by x-ray, she has greatly increased motion, total 135 degrees increase, and there seems to be nothing to cause strain in standing and walking, but if one can judge by her statements, she has little less pain and her range of walking, without being "all in" for the rest of the day, is no better than before operation.

Conclusions: Wisely planned and skillfully executed operations for bone block at joints often result in greatly increased mechanical usefulness and in relief of pain. It is questioned whether this is frequently the outcome of operations for bone block at the hip joint. Of the two cases analyzed, the one for abduction block and for the relief of pain, the pain was relieved and a total of 39 degrees more motion was obtained, but there was an increase in shortening and 23 degrees less flexion; and the other case for adduction block and for relief of pain, resulted in a total increase in motions of 135 degrees and a very doubtful relief of pain. In both, the specific bone block sought was permanently removed and it is to be noted that both were complicated by conditions unforeseen—the man by removing his plaster dressing on the second day and thus causing a loosening of his osteotomized fragments with bad displacements, and the woman in that a neurotic habit prevents the proper judging of the subjective result of pain.

# THE PATHOLOGY AND TREATMENT OF TUBERCULOSIS OF THE HIP-JOINT.

BY JAMES K. YOUNG, M.D., F.A.C.S., PHILADELPHIA.

In considering the pathology of tubercular osteitis, many surgeons proceed directly from the initial stage to ankylosis, oblivious of the well-known law that tuberculosis may terminate at any stage of its course and forgetting that the steady, onward progress of this disease is often caused by inefficient or inadequate treatment, due to neglect on the part of the parents or attendants, or to lack of proper control and frequent checking up, or to reinfection. This occurs especially in hospital cases, although it also occurs in private practice.

Some, considering ankylosis the ultimate goal, endeavor to hasten this end by fixation, without traction or by operative measures.

A similar logic is applied to injuries to joints in laboring classes and in war injuries, where a quick recovery with ankylosis is accepted as a satisfactory result, so that an employee may be returned to his work with less loss of time.

The problem here should be different: a *movable* joint after the inroads of tuberculosis should always be the ultimate aim. If, through inadequate or inefficient treatment or neglect, ankylosis should occur, the result will be equivalent to failure, but in private practice a large proportion of patients will be restored to health with movable hip-joints.

It is erroneous to assume that all joints are similarly affected by disease, since the effects of disease vary with the joint construction, and the hip-joint is unique, in that it stands alone in its pathology.

As has been often remarked, the upper epiphysis and nearly all the femoral neck lie within the capsule of the joint,—and it thus differs little from other epiphyses,—the result being that its blood supply is derived from vessels running along the ligamentum teres and from the vessels in the reflected parts of the capsule and the investing synovial membrane, as well as from vessels that pierce the marginal and epiphyseal cartilages. For a large bone of such texture, such a blood supply is indeed slight. This epiphysis is the most isolated of all the epiphyses.

Nichols notes that:[1]

"In the long bones the disease, as a rule, begins in the epiphysis.

"Tuberculous disease of the joints is, generally if not always, secondary to the disease in the epiphysis in the adjacent bone.

"Hip disease frequently begins in the acetabulum."*

After a thorough pathological investigation of the specimens from his orthopaedic clinic, Allison[2] has come to the same conclusion as to the osseous origin of tuberculosis of joints and the later extension to synovial membrane.

Lovett[3] has expressed himself in favor of the osseous primary origin of tuberculosis of the hip-joint, which he regards as fairly demonstrated.

Since few specimens of tubercular hips are available for laboratory purposes, the pathology can be investigated by means of the rays.

Such photographs are taken at intervals from the same individual and a comparative study is made with plates taken from other persons. The roentgen rays are invaluable in determining the location and the extent of the lesion.

The most frequent form, the femoral, may be followed by the earliest rarefaction of the epiphyseal line to complete destruction and dislocation of the femur.

The acetabular form exhibits, at first, rarefaction of the acetabulum, which deepens if treatment is not adequate. The head becomes eroded and flattened, fitting into the irregular cavity, or the superior portion of the acetabulum disappears from pressure and absorption, presenting the so-called "traveling acetabulum."

If the head, after being in close contact with the cavity of the acetabulum, is dislocated by force, it subsequently dislocates upward, and the head being completely absorbed, we have the upper extremity of the femur extending some distance up above the femur cavity and resembling the pathological entity seen after an acute epiphysitis in its last stage. A clouding of the negative over a joint usually indicates involvement of the soft parts, primarily or secondarily.

Primary synovial infection without osseous involvement is difficult of demonstration in roentgenograms.

A uniform cloudiness of joints without any demonstrable osseous

*In a series of one hundred consecutive cases of excision of the hip-joint for tubercular osteitis, Wright reported ten where, in his opinion, the acetabulum was primarily diseased. ("Hip Disease in Childhood," G. A. Wright.)

structure may be considered as synovial, but sooner or later, in my experience, rarefaction of either the epiphyseal or diaphyseal line of the femur or acetabulum will be present, and if so, synovial infection without osseous involvement (if it occur) must be rare.

As previously stated, roentgen photographs should be taken at intervals of from one to three months and at varying angles, and a comparative study made from plates taken from other patients suffering with the same disease.

The beneficial effects of fixation and traction are revealed in the x-ray plate, through the increased space occupied by the cartilaginous surfaces of the head of the femur and the acetabulum, and also by the smoothness, as compared with the roughened acetabulum, indicative of the unchecked inroads of the disease.

Traumatic synovitis may occur in an individual, where there is a predisposition to tuberculosis, or where this predisposition does not exist.

In the former, recovery is prompt; in the latter, *slight* injury or overstrain produces a stasis in the normal circulation of the cancellous tissue of the epiphysis, and the tubercle bacilli lodge in the end-arteries, and rarefaction begins.

Tuberculosis of joints is, I believe, always secondary to lesions in other organs. The primary focus of infection may be difficult to locate, but painstaking effort will usually reward our efforts. The importance of this thought becomes one of the first magnitude, when we reflect that the disease is hopeless of cure if reinfection is steadily progressing.

Every effort to discover the primary lesion should be pursued with avidity. Starting with the patient's family history, every factor, no matter how apparently trifling, should be thoroughly investigated. Any suspected focus of disease, be it in the tonsils, the teeth, or in the nasopharynx should be removed. In cases of cold abscess, the exploratory puncture and laboratory examination, including injections into the guinea pig, should always precede the evacuation. A differential study of the *other* joints should be carefully undertaken. Has the patient an infective arthritis, a Charcot joint, an incipient osteo-arthritis? Tuberculin tests, local and general, should not be neglected.

Traction and fixation furnish the most satisfactory method of treatment. If the treatment is adequate, absorption of the head is prevented and the rarefied areas of the acetabulum gradually fill in with lime

salts.* In the incipient stage, from absorption of lime salts, we find rarefaction of the epiphysis, of the acetabulum, or of both.

Traction and fixation is the best treatment in private patients and in those under perfect control of the surgeon. This treatment is divisible in three parts.[4]

(a) Bed traction,

(b) Traction fixation splint,

(c) Convalescent traction splint.

*Bed Traction* is employed for a short time only,—that is, while the first brace is being made. Any deformity of the hip or any acute exacerbation would require bed treatment.

*The traction fixation splint* for the first year consists in a posterior bar-brace, made over a cast of the body and extending from the fifth dorsal vertebra down to and including the foot. The pelvis, the thigh and the calf portions are constructed of hardened leather, celluloid or reinforced canvas, the first of these being the best. Two peroneal straps are employed and traction is obtained by means of an anklet and tapes, which pass down through the foot-piece. The foot-piece is always made a half-inch longer than the sole of the foot and provision is arranged for the extension of the brace as the child grows. The foot-piece prevents lateral movement in the hip-joint and this is most important.

As the acute symptoms subside, the x-rays will reveal a re-deposit of lime salts, the joint exhibiting a complete range of motion. At the end of about one year this brace is removed and a convalescent brace is applied.

*The convalescent brace* is made up of a pelvic band, an outside bar with a free joint at the hip and ankle, and a lock-joint at the knee.

The foot-piece is made longer than the leg, so that when the peroneal straps are adjusted, the foot is free from the foot-plate and the patient is suspended by the peroneal straps.

The patient discards the patten and crutches and wears ordinary shoes. This brace is worn about a year, at the end of which time recovery is usually established. When the convalescent brace is applied,

*It is difficult to realize at this time that in the 80's the discussion between the question of fixation or of motion was acrimoniously argued. Toward the close of this controversial period, Stillman ("Modern Treatment of Hip Disease," Geo. H. Davis, 1891) found that while almost all leading orthopedic surgeons used bed traction in some form during recumbency, when apparatus was applied permitting of locomotion, five employed fixation without traction, as compared with fourteen who employed traction apparatus of some kind.

Since 1884, I have constantly and consistently advocated combined fixation and traction in tubercular osteitis of the hip.

the day brace is used at night for two or three months, so as to prevent flexion of the limb at night. The brace is not used for *deformity* of the hip. If deformity occur, the patient is put to bed and bed-extension is applied, or the hip must be placed in proper position. However, after the brace is applied deformity *seldom* occurs. The progress of convalescence is studied by the x-rays, as previously described.

*Constitutional treatment* forms an important adjunct in the management of the case. Calcium salts, in some form combined with thymus gland, is at present the most rational drug therapy. Improved diet and good hygienic environment should not be neglected.

One thing should not be forgotten and it is this: If conservative treatment is instituted early and efficiently carried out, operative procedures will be less frequently required. But there will always be, in neglected cases or where treatment has been inefficient or inadequate, individual cases where operative measures must be employed.

The results of treatment with the author's splint are:

1. A diminished number of abscesses.
2. A shorter time required for cure.
3. Perfect recovery.

Now what constitutes a *complete* recovery? The writer believes the recovery should be so perfect as to form and motion, that the previously affected member cannot be detected by inspection and manipulation. The patient should also be able to take the tests suggested by Sayre, of New York,[5] and previously illustrated by the writer.[6]

Having reviewed in detail the conservative methods of treatment, we now will consider the operative treatment.[7] Operative measures are demanded for (a) the deformity and are also required (b) in the treatment of the arthritis. For the relief of deformity we include forcible straightening and osteotomy.

*Forcible straightening* by itself is often sufficient for the relief of the abduction and flexion deformity during the progress of the disease, if applied at the right time and in the proper manner. Where there is false ankylosis this is all that is required. The patient should be completely anesthetized and the hip may, by a single movement, be brought into its proper position. This should not require much force. If force be required it is better to perform a tenotomy of the contracted muscles, although this is rarely required.

Under no circumstance should the hip be manipulated or rough handling form part of the preliminaries. Buck's extension should be applied

FIG. 1.—Forcible correction for hip deformity. Before operation, June 23, 1920.

from the middle of the thigh down, before the patient is anesthetized. This should be covered with a bandage, and a spica of the hip should be applied while the patient is still under the anesthetic.

A moderate amount of extension should be applied to the limb for two or three weeks, after which the patient may resume the convalescent hip splint. This correction should not be attempted by anyone who is not thoroughly familiar with the treatment of this condition, and the greatest care should be taken not to injure the hip.

Properly performed, this operation is often followed by prompt recovery. The rarefaction in the bones becomes filled with lime salts, the head of the bone continues to grow, and the parts being in their normal relations, according to Wollf's law, are restored to their normal condition.

An excellent result of the beneficial effects of forcible correction is shown in the accompanying illustrations.

The first x-ray, taken June 23, 1920, shows a relapse or exacerbation; the patient walking with a limp and the examination showing marked

FIG. 2.—Forcible correction for hip deformity. Four months after operation, October 5, 1920.

abduction with apparently elongation of the limb and complete limitation of motion. The spica, which was applied at the time of operation, was removed three weeks later, the traction having been continuous and the convalescent splint again applied. (Fig. 1.)

The second x-ray was taken about four months later and showed the femur in good position. The rarefaction of the acetabulum had disappeared and convalescence subsequently established. The patient had normal range of motion and walked without a limp (complete functional and anatomical restoration of the joint). (Fig. 2.)

The first photograph (Fig. 3) of the child shows the splint for the active stage. The second illustration (Fig. 4) shows the convalescent brace, and was taken after forcible reduction.

*Osteotomy* gives very satisfactory results in osseous ankylosis, and the Barton or intertrochanteric operation is productive of the best results. After osteotomy has been performed, the limb is ankylosed in a corrected position and motion cannot be expected. In cases of double ankylosis of the hip, after osteotomies have been performed, the limb should be set in an extended position and not in a flexed position.

FIG. 3.—Author's fixation-traction hip splint.

FIG. 4.—Author's convalescent hip splint.

Under surgical operations for arthritis we include: aspiration, incision, erasion, and excision.

*Aspiration* offers little of curative value, but has a diagnostic value. Puncture as a diagnostic aid in tubercular abscesses has not received the attention that it has always merited and to which the writer has called special attention.[8] For this purpose a small syringe is required and the puncture should be made on the periphery of the abscess, a day prior to the contemplated operation, and the fluid removed for laboratory examination.

The surgeon varies his operation according to the nature of the fluid that has been studied by laboratory technicians. If the fluid be sterile, incision and curettement are indicated. The presence of pyogenic organisms in the aspirated fluid demands antiseptic treatment and drainage. Tubercle bacilli, in addition to pus organisms, call for incision,

curettement, carbolic acid, alcohol, and drainage. After incision of the abscess, the part should always be put at rest with fixation and traction.

*Erasion* of the joint, as practised by Willard, is of value in children and where the inroads of the disease are not extensive. The diseased parts should be located with the rays and removed with a curette, flushing with a hollow spoon, employing a solution of bichloride of mercury. Abscess cavities and disease tissue should be thoroughly removed, because partial removal may be followed by tubercular meningitis.

This operation may be repeated in children and the results are satisfactory as a substitute for excision. Recovery frequently occurs without marked deformity.

Conservative treatment has greatly lessened the frequency of *excision* of the hip-joint, so that it is now seldom employed as a surgical procedure. When excision, however, is demanded it should be done as expeditiously as possible so as to conserve bodily heat and thus obviate shock.

In former years, excision was a favorite operation, and Wright of Manchester, England,[9] who recognized the epiphyseal origin of the lesion, in an elaborate table of one hundred consecutive excisions which he performed between September, 1881, and July, 1886, presents a veritable store-house of scientific treasures in his studies in the gross surgical pathology of coxalgia.

The operation is now seldom seen in hospital practice, and I know of but two cases in private practice where resort to it was found necessary.

The question of *amputation* of the hip in tubercular hip-joint disease occasionally arises where the ilium is extensively involved in addition to the disease process in the femur. If, after mature thought and deliberation, the surgeon concludes that the patient will not survive the operation, such operation should, in my judgment, be declined.

When the disease extends down the femur without much acetabular involvement, there is seldom, or ever, any necessity for amputation of the joint.

A moot question, that is much in doubt and much discussed, is "Shall we curette the sinuses in hip-joint disease complicated with albuminuria?" In my experience, decided improvement often follows curettement, as well as improvement in the renal condition.

As a brief conclusion, I would summarize these important data:

1. Few specimens of tubercular hip are available for laboratory examination, so that one need study the pathology of the affection from a series of x-ray plates.

2. Moderately severe injuries are more favorable to the development of the disease.

3. Tuberculosis of the joint is usually secondary to disease in the epiphysis.

4. In the hip-joint, the disease usually begins in the epiphyseal line of the femur and later extends to the joint.

5. Or the disease may begin in the acetabulum and extend to the joint.

6. Hip disease is usually, if not always, secondary to a lesion elsewhere in the body.

7. Fixation combined with traction affords the best method of treatment.

8. Constitutional treatment should not be neglected.

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# THE VALUE OF THE ROENTGEN RAY IN THE DIAGNOSIS AND PROGNOSIS OF SARCOMA OF THE LONG BONES.*

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ONE of our principal aids in diagnosis and prognosis of sarcoma of the long bones is the roentgenogram revealing the location, size, and, to a certain degree, the structure of the tumor, but most important, early evidence of metastasis to the lung. My own experience, however, leads me to believe that roentgen-ray diagnosis of sarcoma is, at times, dangerous, particularly if the surgeon depends on such data in determining the fate of an extremity. Information concerning the type of tumor, its location and extent, the probable percentage of malignancy, and the presence or absence of demonstrable pulmonary metastasis should, if possible, be included in the roentgenographic report. Roentgenographic examination of the chest should be a routine procedure in all cases of tumor of the bone suspected of being malignant. Whenever possible, before sacrificing an extremity the tumor should be explored, with tourniquet applied, and the tissue examined microscopically to confirm the clinical and roentgen-ray diagnosis.

Thus far the medical profession has been unable to solve the problem of sarcoma of the long bones, largely owing to early pulmonary metastasis. Local excision in early cases, without evidence of pulmonary metastasis, would appear almost ideal, were it not for the local recurrence, and, still later, metastasis. More radical surgery, such as amputation, while less likely to be followed by local recurrence, has done little more than to relieve the patient of the tumor, and to permit temporary freedom from discomfort. Yet this temporary benefit seems justifiable, and at present appears to be the only certain means at our disposal of eradicating the local growth. However, amputation should be performed only when the diagnosis has been definitely confirmed by exploration and microscopic examination. Treatment with radium, the roentgen ray, and Coley's toxin, appears to be beneficial in the control of certain malignant lesions of the bone, but thus far none of these aids has proved adequate.

*Read before the American Orthopedic Association, Washington, D. C., May, 1922.

Every injury to the bone or suspected lesion should be examined roentgenologically. By the more common use of the roentgen ray in diagnosis and by constant reiteration of the danger of sarcoma, the public and the medical profession will realize the importance of early diagnosis in sarcoma, and the results thus may gradually become more satisfactory. Watchful waiting should be condemned. Unfortunately, many patients seek medical aid long after the lesion should have been recognized as a menace, and when it is clinically evident that the growth is malignant often metastasis has already taken place.

The term "central" or "medullary sarcoma" is used to designate the sarcoma confined to the substance of the bone. It usually occurs in the cancellous bone, and may extend outward evenly in all directions, or it may destroy cortex and periosteum at one side, bursting outward and rapidly invading the periosseous tissues. The borders of such central sarcoma are usually hazy, single rather than multilocular, hardly resembling the more or less well defined outline seen in cysts of the bone, osteitis fibrosa cystica, giant-cell tumors, and chondromas. The body of the tumor found in the central or medullary types may cast a slight shadow or none at all, showing a clear, almost cyst-like structure, due to absence of lime salt, bone, and so forth. Certain forms of sarcoma, however, appear to cast a shadow even more dense than the adjoining bone itself. The striations and trabeculations seen in osteitis fibrosa cystica and chondroma are less commonly associated with central sarcoma. Central sarcoma, confined to the bony substance, should be more amenable to surgical treatment than sarcoma already invading the soft tissues, yet pulmonary metastasis may occur even in the early cases and it is well to attempt exclusion of metastasis by roentgen ray in all cases. It would then appear rational to attempt local excision, radium, and later bone grafting, though in my experience such procedure has not been very satisfactory.

In the term "periosteal sarcoma" are included sarcomas arising from or apparently principally involving, the periosteum. Thus a central sarcoma may be diagnosed by the aid of the roentgen ray, and on further examination prove to be periosteal. The differentiation is not always clear, especially from the roentgenographic appearance, and is often impossible until operation is performed, or postoperative dissection is made of the specimen. While appreciating the possible danger of involvement of the soft tissue (periosteal) by sarcoma, I doubt the accuracy of the classification, at least from the roentgen-ray findings. If patients are seen early the differentiation of periosteal and central or medullary sarcoma may usually be made roentgenographically, though the evidence is of doubtful value, malignancy and benignancy, and oper-

ability with relation to metastasis being the vital consideration. The type of periosteal sarcoma showing radiating lines at right angles to the shaft, or from the point of origin, is one of the most characteristic of all sarcomas of the bone, and makes possible an almost certain diagnosis from the roentgen-ray findings alone. However, inflammatory changes often simulate the roentgen-ray appearance of sarcoma so closely that diagnosis may be difficult without exploration and microscopic examination. Periosteal sarcomas rapidly invade the soft tissues in all directions, destroying the cortex, and extending through it into the medulla. Certain types of periosteal sarcoma cause an increased density, while others cast dim shadows or none at all in the body. They may produce flakes of bone in the periphery, which are frequently to be made out in that roentgen-ray, and egg-shell crackling is felt on firm palpation.

Occasionally sarcomas, apparently arising from periosteum, resemble, roentgenographically, osteochondromas. They may involve both cortex and medulla, and extend into the periosseous structures as pedunculated tumors, casting shadows of varying density with linear markings radiating into the tumor from the pedicle, and with a bony deposit in the margin of the tumor. A denser sarcoma has been observed resembling exostosis roentgenographically, with an irregular, well-defined border.

Marked destruction of both cortex and medulla without apparent early periosseous invasion has been observed, the condition somewhat resembling syphilis, or a diffuse, low grade osteomyelitis.

If patients have been operated on previously, the interpretation of the roentgenogram as to malignancy and benignancy is especially difficult. I have observed cases of postoperative infected sarcomas and benign lesions of the bone in which the interpretation was practically impossible.

## SUMMARY.

The roentgen ray is one of the most valuable, if not the most valuable, aid in the diagnosis and prognosis of sarcoma of the long bones. It reveals the location, size and extent, and to a certain degree, the structure and origin of the tumor and the presence of metastasis. It is the earliest aid in determining the presence of pulmonary metastasis, although the absence of demonstrable lesions does not mean that metastasis has not occurred. Roentgenograms of the lungs should be made as a routine measure in every case of suspected malignant tumor of the long bones, particularly if surgery is contemplated for removal of the primary tumor.

Various types of sarcoma, central or periosteal, with marked differences in density, structure, and location may be observed roentgenographically. The roentgenographic appearance of these types, while not always characteristic, is, nevertheless, fairly characteristic and yields a high percentage of accurate diagnoses. Operation should seldom be resorted to, and amputation never, without exploratory operation with the use of the tourniquet, and microscopic proof of malignancy. There may be exceptions when the member or joint is already so far involved that it is obvious that the extremity cannot be saved.

While the roentgen-ray examination is a valuable aid in diagnosis, the history and clinical findings and, whenever possible, exploration of the tumor, and its gross and microscopic appearance must be considered in determining the diagnosis, prognosis, and treatment. The prognosis, always grave, is hopeless with definite pulmonary metastasis demonstrated in the roentgenogram.

## REPORT OF CASES.

CASE 1 (A239524). A boy, aged 12 years, came to the Clinic in July, 1918, with aching pain and swelling in the upper third of the left humerus. The arm had been severely injured, possibly fractured, eight years before. Two months before, it had been traumatized. The arm was freely movable and without pain or tenderness; a thickening of the upper third of the humerus was apparent. The parents and the child were greatly alarmed because "sarcoma, cancer of the bone" had been diagnosed by the roentgen ray and a Berger amputation of the shoulder advised by several surgical consultants.

A diagnosis of fibrocystic disease was made in the Clinic from the clinical and roentgenographic evidence, and a conservative operation advised. The thin shell of cortex was broken through and a specimen removed which verified the diagnosis; following this the wound was thoroughly curetted and closed without drainage. Improvement in the humerus, as shown by the roentgenogram, has been observed until the normal was practically reached. The patient is alive, with good function of the arm more than four years after operation.

CASE 2 (A193388). C. A. M., a boy, aged 14 years, came to the Clinic May 7, 1917, because of swelling of the lower third of the right thigh and knee.

In February he had fallen and bumped his right knee. Soreness was noted for a few days. In the latter part of March the right thigh and

knee began to swell, the enlargement slowly increasing, with only slight pain in walking. He lost weight gradually.

A hard tumor of the lower right thigh, tender on pressure, was found. Motion of the right knee was limited. The knee flexed to an angle of 120 degrees. Examination of the urine was negative. The hemoglobin was 68 per cent. The leucocytes numbered 10,400. The Wassermann reaction was negative. Roentgenograms revealed sarcoma of the lower one-third of the right femur, and the lungs were negative for metastasis. The condyles were not involved. On May 10 the right thigh was amputated at the upper third. The pathologist reported mixed-cell sarcoma. Coley's serum was advised. The patient died July 7, 1917, three months after operation, probably of pulmonary metastasis. Metastasis was undoubtedly present at the time of operation, but not discernible in the roentgenogram.

Case 3 (A365027). Mr. M. P., aged 27 years, registered at the Clinic August 9, 1921, complaining of pain in the right knee, which he had wrenched in a jump from a wagon in 1903. There was no locking nor swelling. Two operations had been performed without appreciable results. In 1919 he had contracted influenza, the knee had become very painful and swollen, and he was obliged to use crutches. He was unable to extend the leg.

The patient was found to be in good general condition. The temperature, pulse, and blood pressure were normal. The enlarged right knee was markedly tender and painful; it was held at fixation of 160 degrees. The urine contained an occasional pus cell. The hemoglobin was 70 per cent. and the leucocyte count 11,600. The Wassermann reaction on the blood was negative. Destructive arthritis of the right knee, with considerable synovial thickening, was diagnosed from the roentgenogram. On August 13 the right knee-joint was opened and a sarcoma of the periosteum of the mixed-cell type was discovered. The tumor had originated on the posterior surface of the lower part of the femur and had pushed its way through to the anterior part of the joint. The thigh was amputated, and roentgen ray, radium, and Coley's toxin were given. The patient is still under treatment 15 months later and is in excellent condition.

Case 4 (A266000). N. H., a boy aged six years, was brought to the Clinic for examination March 21, 1919. He had had pain and swelling in the right leg for 14 months. Several exploratory operations had been

performed for osteomyelitis. He was brought to the Clinic because of persistent cough which had followed an attack of influenza four weeks before, and a tumor in the calf of the right leg following operations elsewhere. The circumference of the right leg was 12 inches, that of the left seven inches. The superficial veins were prominent. The temperature was 100, the pulse 118. Primary periosteal sarcoma with metastasis to the lungs was diagnosed by the roentgenogram. The patient died within a few weeks.

CASE 5 (A247227). G. T., a boy, aged 16 years, came to the Clinic September 30, 1918, with a swelling of the lower end of the right femur and knee. Two months before, he had scratched his right knee with barbed wire; the synovitis which followed had disappeared. He then had mumps and the tumor had grown rapidly since. His home physician had aspirated the knee with negative results. Roentgenograms had been taken and malignancy suspected, and he was referred for our opinion as to type of tumor.

Examination showed sarcoma of the right femur and no evidence of metastasis of the lung. The patient was referred back to his home physician for operative treatment. The Wassermann reaction was negative. He died of recurrence and pulmonary metastasis December, 1920, following amputation.

CASE 6 (A359780). Mr. J. W. V., aged 58 years, came to the Clinic May 31, 1921, complaining of pain and swelling in the upper third of the right humerus of six months' duration. He remembered that 20 years before a similar pain followed an injury, and he was treated for neuritis. Just before the present attack he had twisted his shoulder. He came for consultation because sarcoma had been diagnosed, and a hopeless prognosis had been given.

Exploration was performed and the condition was diagnosed hemangioma. The upper half of the humerus was excised and a homogenous bone graft implanted. The patient recovered satisfactorily, returned to his work as a clerk, and is in good condition. Recent roentgenograms reveal the graft to be in good position and united. The patient still wears a protective dressing.

CASE 7 (A168792). Mrs. J. B. W., aged 53 years, was examined in the Clinic in August, 1916. She complained of nervous indigestion, insomnia,

rheumatism, and lameness of the left knee. Lameness and stiffness had been present for seven years, although there was no limitation of motion, no deformity nor tenderness. A diagnosis of sarcoma had been made elsewhere and amputation of the hip had been advised, following consultation with several eminent surgeons.

The urinalysis was negative; the hemoglobin was 80 per cent. and the leucocytes numbered 5200. The tonsils were enlarged and contained septic material. Roentgenograms showed the presence of a tumor in the lower end of the left femur which was confined to the medullary and cortical portions and was unlike any other tumor in this region I had ever seen. Other roentgen-ray findings were negative.

On August 18 the tumor was explored and found to be a chondroma. Radium was used. April 5, 1917, the tumor was curetted and the cavity filled with fat from the abdominal wall. The patient has been walking now more than six years. Thus far there is no clinical nor roentgenographic evidence of recurrence.

Case 8 (A287181). Mr. J. J., aged 29 years, came to the Clinic August 20, 1919, because of a recurring tumor of the left hand. About four years before, he had noticed swelling of the thenar eminence of the left hand. The swelling slowly reduced and interfered with flexion of the thumb. After 18 months the tumor was removed. The hand recovered full usefulness and remained normal for two years; then it again began to grow, involving the thenar eminence and outer side of the palm.

The examination revealed a hard bony tumor lying between the first and second metacarpal bones. The patient was well developed and well nourished; height five feet, eight inches; weight 154.5 pounds. The left arm was atrophied. Examination of the urine was negative. The hemoglobin was 69 per cent.; the erythrocytes 468; the leucocytes 6000. The Wassermann reaction was negative. Roentgenograms revealed the involvement of the hand and multiple metastasis to both lungs.

Case 9 (A290902). Miss G. M., aged 27 years, came to the Clinic complaining of swelling and stiffness with pain in the right knee, of about 18 months' duration. Arthritis had been diagnosed and tonsillectomy performed. The swelling had continued, but more slowly recently and with less pain. The patient had lost weight and strength.

A hard tumor, extending from the middle of the femur to below the knee, and a large hard mass in the right axilla were found. Roentgenograms of the right femur revealed mixed-cell sarcoma with destruction

of the lower half of the shaft of the femur. Metastasis was found in the base of the upper left lobe of the lung.

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# AN UNUSUAL CASE OF CONGENITAL ASYMMETRY OF THE PELVIS AND OF THE LOWER EXTREMITIES.

BY G. PEREMANS, M.D., BOSTON.

*From the Orthopaedic Department of the Children's Hospital, Boston.*

As regards congenital lesions, there has been much written about the tibia and the fibula, less about the femur and little about the muscular contractions not due to spastic paralysis. Therefore, it has seemed to us that the report of a case involving all these deformities would be of some interest.

H. S. is a girl 7½ years old; her parents and sisters are living and well; neither hereditary diseases nor bone deformities are present in the family. She was born at full time, weighing 7½ pounds, after a normal labor. Since then, she has had measles, mumps, chicken-pox, and occasionally tonsillitis.

She was seen for the first time, at the age of three months, in the Orthopaedic Out-Patient Department of the Children's Hospital, Boston. Since the birth, the parents had noticed some crookedness of the left leg and a contraction of the knee, both painless. At the examination the baby showed a left leg somewhat shortened, a small patella, and a limitation to extension of about 15° from the straight line. From an x-ray of the thighs, taken three months later, the left femur was estimated to be 2.5 cm. shorter and much smaller than the right. When the child began to walk there was a slight limp, which increased with the years, and some adduction was noticed later in the right foot. The treatment consisted of daily stretching of the knee and of the wearing of soles raised one-quarter inch on the outer side for the right, and a high sole for the left foot. No change in her condition was noted and in November, 1922, she was admitted to the wards.

The physical examination shows a well developed child, in good health, without any peculiarity in the head, the upper extremities, and the thorax. In the lower limbs, we find the right leg of normal size, in slight adduction, and the left somewhat shorter, with the knee flexed, and a visible atrophy between the anterior superior spine and the ankle, but principally marked in the buttock and the mesial region of the

lower third of the thigh. The skin seems of the same color, thickness, warmth on both legs, without oedema, cyanosis, ulcers, or constrictions. The gluteal fold has disappeared on the left side. The left patella is very small and easily movable. All the motions of the joints are normal in both legs, except that extreme abduction of the right thigh is prevented by some contraction of the adductors, and except, also, total extension of the left knee, which remains flexed to about 25°, because of the contraction of the inner hamstrings, combined with the lessened power of the quadriceps. The back shows a slight total left dorsal curve. The patient walks with the pelvis tilted downward towards the left side, with the left knee slightly flexed. There is double genu valgum, adduction of both legs and a left equinus.

The measurements are as follows:

| *Right.* | | *Left.* |
|---|---|---|
| 56.4 cm. | ...Length between ant. sup. il. spine and int. malleolus... | 49.2 cm. |
| 27.6 cm. | .....Length of femur..... | 24 cm. |
| 2.1 cm. by 2.1 cm. | .....Patella..... | 3.6 cm. by 2.7 cm. |
| 24 cm. | .....Length of tibia..... | 23.4 cm. |
| 12 cm. | ...Length between external malleolus and tip of big toe... | 12 cm. |
| 10.8 cm. | ....Distance between umbilicus and ant. sup. il. spine.... | 12 cm. |
| 34.8 cm. | .....Circumference of thigh..... | 33.6 cm. |
| 25.8 cm. | .....Circumference of knee..... | 25.2 cm. |
| 21.6 cm. | .....Circumference of calf..... | 19.2 cm. |
| 15.6 cm. | .....Circumference of the leg above the ankle..... | 15 cm. |

The muscle examination reveals on the left side a poor quadriceps, a fair outer hamstring, a normal or very slightly contracted calf group and normal toe flexors. All the other muscles have good power. On the right side, all the muscles are normal, except that the right lateral abdominal is a little weak. The muscle balance test of the left quadriceps registers a power of eight pounds (normally 30 pounds, at 7 years). All the others show practically normal power.

The x-ray picture shows: no bone changes in the upper extremities; a normal spine with a slight left dorsal scoliosis; an asymmetrical pelvis, with a left iliac bone reduced 6 mm. in height and a left pubic bone somewhat narrower than the right; the left iliac crest 2.7 cm. below the level of the right; the left femur with an angle more obtuse, 155° instead of 150°, and some atrophy of the shaft, which is reduced 6 mm. in width, while the cortex is 3 mm. narrower than the right. The left tibia is 3 mm. narrower than the right, with some atrophy also; the left fibula medially rotated, without narrowing; there is no bone destruction, but a marked decreased density throughout these bones.

H. S. Lateral view, November, 1922.

H. S. Posterior view, November, 1922.

The reflexes are normal except the left knee-jerk, which is absent. No Babinski, ankle clonus, Gordon, or Kernig, can be elicited. The superficial and deep sensibility is normal. The Von Pirquet and the Wassermann reactions are negative.

The intelligence is that of a child of her age.

This picture is common in cases of early infantile paralysis, but there is no history of such a disease and the symptoms were noticed at the birth.

Treatment: A plaster-of-Paris cylinder was applied to the leg from the ankle to the groin, with the knee maximally extended. Some hours thereafter, at the level of the popliteal space, a transverse split was made and by successive throat-sticks inserted in this split, the extension became quite complete after three weeks, so as to increase the length of the leg to about 3 cm. A caliper splint was then applied, which will maintain this correction. A shoe was fitted with a high sole to compensate for the shortness of the limb.

The few cases reported which have a direct relation to the affection of our patient, are the following:

H. S. X-ray, left knee.

*Vines Ellis* has described a specimen, now in the Museum of University College of London, with a pelvis without acetabulum, articulated at the anterior superior iliac spine with irregular pieces of bone. The right femur is absent, the left one is rudimentary. The right tibia is forked and shortened; the left tibia and fibula are of the usual size and the knee-joint is complete.

*Rundle* has made a study of a boy ten years old with short legs, whose fingers touched the ground in the erect position. His right leg, 9½ inches long, showed a talipes equinus, while his left one, 14½ inches long, was in an adducted position out of line of the center of gravity of the body, with the foot in calcaneo valgus. The 5¼ inches difference in length was compensated for by an oblique pelvis tilted downward to the right side and a lateral spinal curvature. An autopsy made at 30 years of age established the fact that the asymmetric pelvis was more

H. S. X-ray, right knee.

developed on the left side, and that there was a lack of acetabulum on both sides, a short femur, a diminished fibula, and a short, enlarged tibia with an almost normal foot on the right side, while the left tibia and fibula were of full length and the femur absent.

*Joachimsthal* reports the case of a woman of 22 years with a congenital deformity of the right leg and the right half of the pelvis. On this side, only the ischium is of normal dimensions, but twisted with the tuberosity pointing upward; the skeleton of the lower extremity is formed of two small bones, one medial and anterior, resulting from the fusion of the femur and the tibia, the other, lateral and posterior, being the fibula.

*Scarlini* describes a boy of 9 years, whose left half of the body and upper right extremity are quite normal, but who is affected with a rudimentary right leg coming about to the level of the left knee, and showing a permanent flexion at the hip and at the knee, while his right foot

H. S. X-ray of pelvic and femoral bones.

has lost its normal size and forms a rudimentary irregular appendix. According to the x-ray there is a marked hypotrophy of the sacrum; the right half of the pelvis is composed of an ischium, forming the inferior part of the acetabulum situated at the level of the third sacral vertebra. The femur is extraordinarily small, without a trochanter, with 11 cm. shortening and a diameter of only half that of the normal femur. In the leg there is only one bone, the tibia, with 2 cm. shortening and a diminished density. The bones of the foot are abnormal. There is no

astragalus, and the calcaneus, arrested in its development and modified in its shape, is articulated with a series of little bones impossible to classify.

*De Castro* cites a case in which the left femur was represented only by its distal epiphysis and the iliac bone smaller on the same side, all of the rest of the skeleton being normal.

Etiology: As to the etiology, two theories have attempted to explain these congenital abnormalities. The first is based upon exterior causes like pressure of the limb in a defective position by narrowness of the uterus or lack of sufficient amniotic fluid or fixation by the umbilical cord or by amniotic bands. But this opinion has fewer and fewer defenders in the cases where no external skin constrictions have been discovered at the birth. For the second, intrinsic factors are held responsible. Abnormal osteogenesis is inferred, explaining in the same way rudimentary or lacking bone formation and supplementary or heterotypic bones by the disturbance of the functions of the osteogenetic centers or the production of abnormal osteogenetic centers. Thus the entire limb may be modified in very different ways.

Now, what is the determining cause? *Dareste* thinks it is an arrest of development of the amnios with compression of the leg, producing bone atrophy and lessened blood circulation. Other authors like *Klippel* and *Rabaud* are of the opinion that it is due to a lack of general nutrition, causing local disturbances. The experiments of *Poynter* seem to afford some support to this assertion. In a series of chick embryos in which development was disturbed in order to study the process of dissociation, lateral asymmetry frequently occurred. Eighty per cent. of those in which circulation was partially destroyed or its development prevented showed lateral asymmetrical development or degeneration, and the entire lateral half of the body may share in the delayed development. This is also corroborated by the results of *Loeffler's* work on congenital contractures, showing that ischemia of the muscles plays an important rôle in their contractures.

To sum up: Probably the origin of the affection of this child is the result of a disturbance of the circulation at an early period of intrauterine life at the time of formation of the left femur, tibia, and fibula, but having stopped or been compensated for by lateral anastomosis when the foot was developed.

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# PHYSIOTHERAPY IN BACK SPRAINS.

BY A. GOTTLIEB, M.D., LOS ANGELES, CALIF.

THE incompleteness of pathological diagnosis, the disregard or only empirical use of physical therapy, and the orthodox treatment with prolonged rest and immobilization cause individuals who have sustained back injuries to suffer such long periods of disability.[1]

Treatment with mechanical and physical remedies can be efficient only if the therapist understands the underlying pathology and is well acquainted with actions and modes of application of the measures which are at his disposal.

Concerning the pathological anatomy of back sprains, great difficulties are encountered in view of the limited clinical data to determine the damage to fibrous, muscular, and ligamentous structures. The radiograph reveals only bone changes, such as fractures, neoplasms, bone atrophy or hypertrophy, while it discloses nothing about the condition of the soft tissues of the back involved in sprains, contusion of muscles, or tear of ligaments. The x-ray findings aid, however, by contributing to our knowledge what factors preëxisted or accompanied the injury to influence the spinal muscles and ligaments. The damage to the latter is determined by the history, the patient's complaints, and the physical findings. It is essential to obtain a complete history, with special attention to occupation and customary posture at work, with a full understanding of the manner of force and the mechanism of production of the injury. The complaints—pain, tenderness, stiffness, and weakness in the back—must coincide with the facts of the history and correspond in location and severity with the data obtained relative to the injury. The clinical findings must be regarded as logical sequels of the above factors: history and complaints.

Clinically important are the peculiarity of spinal deviation; the comparative size of the erector spinae and adjunct spinal muscles, *i.e.*, atrophy or hypertrophy; the distribution of tenderness and spasm, which are most valuable aids in locating the lesion, and, finally, any previously existing cause of backache of local, remote, or constitutional origin.

To exclude possible malingering, so apt to occur in compensation patients who have sustained back injuries, attention must be paid to the

general attitude of the patient towards the examiner: his answering questions, his aptitude to exaggerate facts and complaints, and his resentment to minimizing the seriousness of his accident and suffering.

With the above data at hand, excluding spinal fractures and backaches of other than traumatic origin, we may attempt to draw a pathological picture and establish a diagnosis of sprained or contused back, acute or chronic, the physiotherapy of which the writer desires to present.

## ACUTE BACK INJURIES.

The object of physiotherapy here is the removal of inflammatory products in the traumatized tissues. As these cases never present themselves for operation or post mortem examination, the exact pathology can be deduced only from our knowledge of traumatic inflammation consequent to muscle and fibrous tissue rupture and ligamentous tear, *viz.*, petechial bleeding, round cell infiltration, and serofibrinous exudation. Only after excessive trauma may there be found additional injury to the nerve supply and temporary or permanent paralysis of the muscles.

To disperse this inflammatory exudate and to prevent the establishment of stasis one of the mechanical electric modalities must be locally applied. The term mechanical is used advisedly because such is their action, since they cause contraction of the tissues required to force out, by way of the lymphatics, the accumulated fluid, including the round cells and other degenerative waste. Of such modalities there are at our disposal the induction, the sinusoidal currents, and the high frequency or static sparks. Either of these can be chosen or be used alternately on successive days of treatment, as is the custom of the writer.

Preceding this application, the back is exposed to radiant light and heat from a high candle power incandescent lamp or from a hood lined with numerous light globes. This penetrating heat is effective in relieving muscular spasm and pain by enlarging the channels of circulation through the dilatation of the capillaries.

Following the electrical treatment, manual massage and light mechanical vibration are applied to further disperse the effusion and to promote normal blood supply, to hasten repair, and to prevent adhesions. Of the massage procedures only two are applicable here: petrissage and effleurage in the direction of the lymphatic flow. For the erector spinae muscle group draining into the cervical and the inguinal glands, the stroking must be directed upward and downward, instead of in one direction only, as in all other muscles of the body.

Massage is succeeded by resistive exercises, selected according to indications for each individual case, to overcome the muscle spasm. These movements are executed in a direction opposite to the contracted muscles, *i.e.*, the antagonists to the spastic muscles are made to work to overcome the spasticity. When the spasm is abolished, corrective movements to increase muscle strength are added.

In massage and in exercises the operator must guard against fatigue of the muscles lest spasm increase and the treatment defeat itself. To be efficient, both must be executed most gently and within the limit of pain.

While thus treating the patient every day, the back is protected by means of adhesive strapping, by a pelvic belt with back extension, a spinal brace, or a removable plaster of Paris jacket. For most cases adhesive strapping will suffice, since the patient may be restored to usefulness within about one week; in more extensive injuries a permanent removable support is needed to protect the spine, especially for the night when unconscious moving about may harm the healing tissues. The average acute back sprain will be restored to normalcy in two to three weeks.

There are acute cases which do not respond readily to this form of treatment, but require additional spinal manipulation, as practised so extensively, and at times successfully by adherents to drugless cults. The pathology of such cases, though not definitely established, is undoubtedly a mild displacement or subluxation of joints as discussed by Fassett,[2] Davis,[3] Marshall,[4] and other medical writers, and as experienced by myself by relieving pain and back fixation through a sudden "thrust" given to the spine in the hyperextended position. The patient may be awake, or under a general anesthetic if the cramped position cannot otherwise be overcome.

Following forcible manipulation, I proceed with physiotherapy and back protection, as outlined above.

## CHRONIC BACK SPRAINS.

Physical therapy should not be instituted unless it has been established definitely that we are dealing with an organic condition, and not with an hysteric or compensation-neurotic individual. The neurotic is best helped by a permanent disability rating; the hysteric by neurologic treatment without or with physiotherapy, as described by the writer in a previous article.[5]

Chronic cases are the outcome of prolonged rest and immobilization in a plaster jacket or brace with inefficient or no physiotherapy at all in the acute stage. Instead of removing pathological products and diminishing the accumulated debris, they have been allowed to persist, to organize fibrous tissue to be deposited within the muscles and muscle sheath—thus a fibrosis to become established. The organization of effusion may even lead to scar formation which may eventually contract and result in a persistent spinal deviation, or the organized fibrous tissue may undergo degeneration and, in rare instances, ossification.

With this pathology at hand our aim should be to convert the inadequate state into an adequate reaction by means of physical modalities which will soften the organized scar tissue, make it more pliable, and create within the fibrosed muscles an artificial hyperaemia and effusion, to be dispersed later by mechanical means.

The softening effect is attained by the aid of stimulating agents which will produce local hyperaemia. Beginning with radiant light exposure from high candle power incandescent lamps to cause superficial heating, the treatment is followed by the passage through the deeper tissues of the high frequency electric current which produces heat within them, the so-called diathermic current. Surface and deep heating are preparatory to electric modalities which are to succeed, such as negative galvanic ionization with chlorine or iodine ions to augment the softening of organized tissues, and the static or faradic currents to disperse the inflammatory products thus created from the muscles and ligaments. The sitting is concluded by vibration and massage to dissipate to the utmost the exudate from the superficial and deep layers.

With the massage are combined exercises, passive and resistive, to stretch the contracted tissues, to increase spinal motion, and to gain muscular power. Overuse, fatigue, and pain elicitation must be guarded against at all times, just as in the acute stage.

The spine is not immobilized in an irremovable jacket, but after each treatment which is given daily, unless contraindicated by pain and increase of spasm, a spinal spring brace or a canvas belt with a spring back extension is applied to partially inhibit motion. The brace is worn at night, while in the daytime it is removed during treatment and when the patient exercises; exercise being encouraged and performed within the limit of pain.

The time required to restore the spine to a functioning condition is about 6 to 10 weeks, during which period the support is worn and then gradually discarded.

The treatment outlined for chronic sprains should be applied to healed fracture cases as well. After the fractured spine has been immobilized for about six months, as customary, it should be dealt with therapeutically, like a chronic sprain of muscular, ligamentous, or fibrous tissues. The only difference to be observed is the limitation of exercise, because of the uncertainty of perfect and strong callus. The disregard of physiotherapy and the protracted immobilization are the reason of the long lasting disabilities, two years or more, for spinal fractures.

## SUMMARY.

To obtain a pathological picture and derive the diagnosis of back sprain, a complete history of the patient, the manner of production of the trauma, and the clinical, laboratory, and radiographic findings must be secured in order to exclude cord and bone lesions, and backaches of remote and constitutional origin.

Having established the diagnosis of back sprain by excluding other possibilities, local physiotherapy should be instituted with only partial restriction of back motion. This will reduce the time of disability to a minimum and prevent the formation of chronic back sprains. If such have developed or have resulted from the necessary immobilization of spinal fractures and acute spinal arthritides, they should be submitted to a thorough treatment with physical modalities, instead of remaining mobilized for a longer period of time.

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# REPORT OF A CASE OF MYOSITIS OSSIFICANS PROGRESSIVA WITH BIBLIOGRAPHY

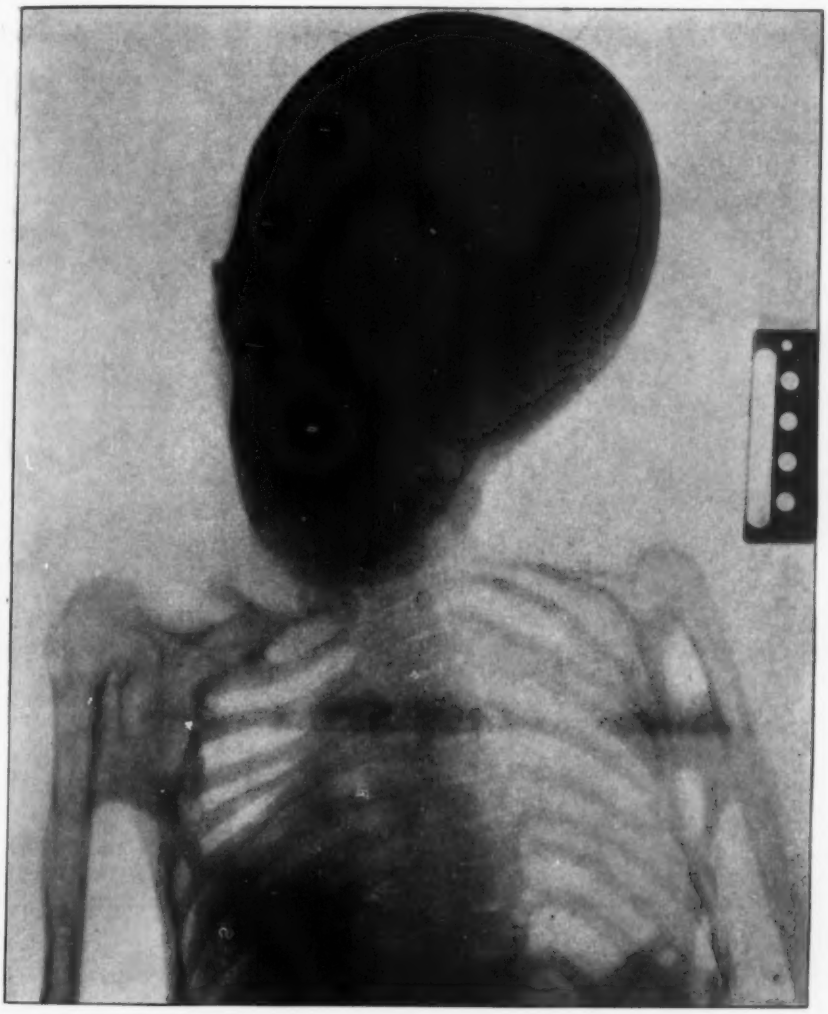
BY JOHN JOSEPH NUTT, M.D., NEW YORK.

R. K. Ten years of age, one of twins. Normal birth. No instruments. Has had whooping-cough and scarlet fever; no other illnesses. Had fall from high chair when one year of age, and 6 months later present condition started in his neck. In the words of the mother, "It was poulticed, and it went all over his body." He did not become much worse until five years of age; since then it has been slowly progressing. He has three brothers and two sisters, living and well. One sister died of the whooping-cough at the age of two years. There is no history of a similar condition in any branch of the family.

Present examination shows well appearing boy of apparently normal height and weight, holding his head in position of wry neck. It is distinctly noticeable that there is no movement of the head.

Examination discloses the following muscles as being involved: the masseters, fixing the inferior mandibular articulation so that only one-half an inch separation of the incisors can be obtained, none of the muscles of expression; both sterno-mastoids, trapezius, and probably complexors, the latissimus dorsi, the external oblique abdominalis of the right side, both pectoral muscles, the major on each side changed to almost solid plates of bone, the subscapularis and teres major, the biceps and coracobrachialis and triceps. There are but three or four degrees of motion at the elbows, movement at the wrist fair, right arm fixed in pronation. A remarkable ridge of ossification extends downward and backward in a serpentine manner from the left nipple for three and a half inches. It is raised from the surrounding surface one-half inch, with a base one-quarter of an inch wide. The skin is non-adherent except in one spot, and here it is probably due to pressure with slight inflammation. The adductors of the right leg are ossified throughout their length. A plate of ossification extends down the fascia lata. The ossification is less marked below the knees, although the knees themselves are markedly involved. No ossification found in the skin after a thorough search. No microdactylia present. Wassermann negative. Blood analysis showed decrease of calcium content. Five c.c. of the blood removed for examination was injected into the quadriceps of the left leg. The same quantity of sterile salt solution injected in the other quadriceps in similar

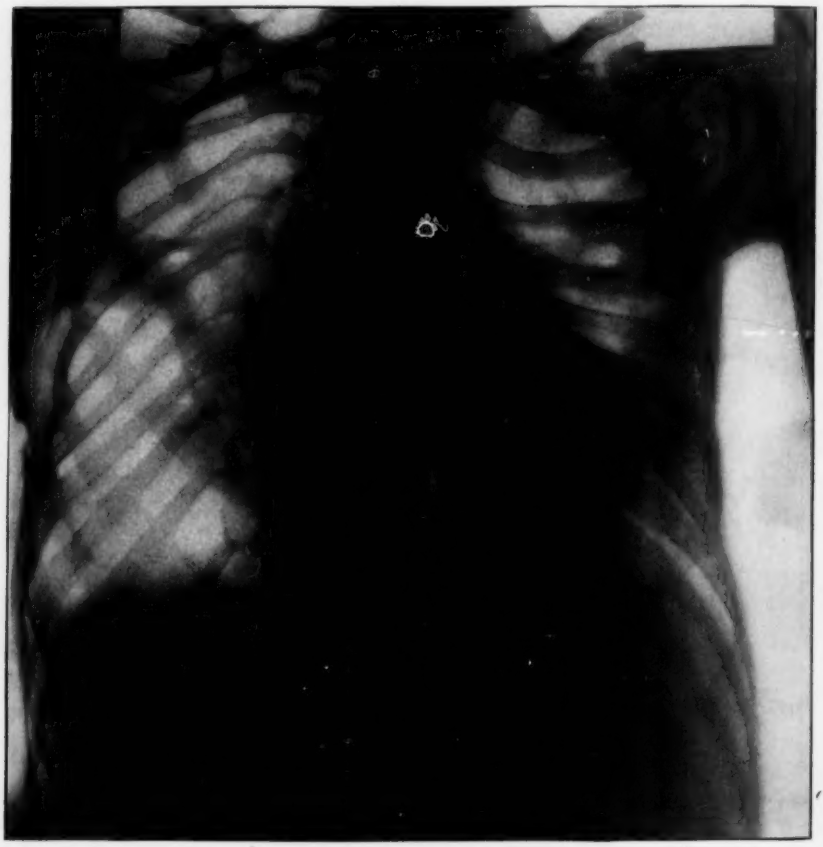
[Radiographs taken by Dr. Charles W. Fairchild.]



position and manner. X-rays taken two weeks later failed to show any changes at the sites of injection.

Myositis ossificans progressiva is a disease of early life in which the fibrous tissue in and about the muscles changes to bone. It steadily progresses, and may eventually render the subject a veritable ossified man. No therapeutic measure is known to retard its progress. It is

usually accompanied by defects in the development of the toes or fingers (microdactylia). It differs from myositis ossificans circumscripta and



myositis ossificans traumatica in that trauma in the light of external violence does not seem to be an etiologic factor. Myositis ossificans traumatica has a satisfying etiological factor in the torn and displaced periosteum. But the periosteum can be absolutely ruled out as a causative influence in this disease.

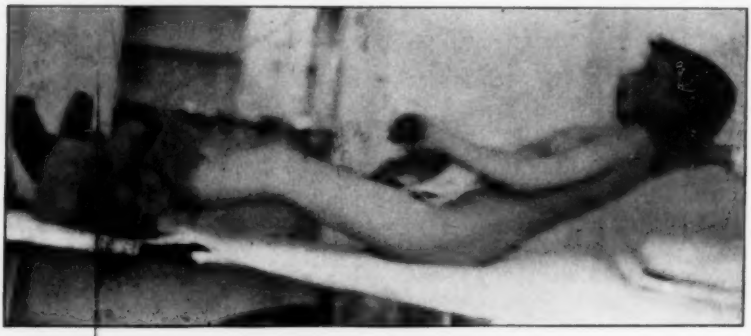
Most exhaustive studies of the metabolism, in which the intake and output were analyzed, failed to show anything abnormal. The excretion of calcium is unaffected. Austin states that the patient whose calcium metabolism he studied "seems to offer a perfectly normal metabolism,

which consists in a calcium equilibrium on a mixed diet of sufficient amount; a loss on an insufficient amount of a mixed diet, and a loss on an ample diet of foods poor in calcium." As grapes, oranges, and bread appeared in this diet, a lack of carbohydrates could have had nothing to do with the loss of lime in the body. Goldthwait, Painter, Osgood, and

McCrudden, in a very carefully conducted series of investigations, demonstrated a constant loss of lime in osteomalacia. Absolute loss of lime has been demonstrated in pernicious anemia. When loss occurs in phthisis, it is due to inanition and not to the disease. The calcium loss which invariably follows insufficient nourishment can be accounted for only by the assumption that the bones are broken down to a certain extent, thus setting their calcium free. This assumption has been substantiated in dogs (Forster) and in human beings (Munk).

Microscopic study of the newly formed and forming bone shows nothing which differs from new bone formation following trauma. There is present haemorrhage, connective tissue hyperplasia about the clot,

calcification, and ossification. The haemorrhage may mechanically start the cell changes by pressure,—may provide the calcium which is necessary or may do both. Both of these factors exist probably frequently in everyone, and yet this excessive bone formation is a rare condition. Since the microdactylia is present in the majority of cases, it would seem justifiable to look for congenital malformation in other body cells. Thus we



may account for abnormal capillary walls, easily permitting extravasation of blood, and likewise abnormal connective tissue cells, permitting the ready production of necrosis, calcification, and ossification.

Rolleston classified this as a developmental disease of the mesoblast, but Rosenstein found bone formation in the skin of his case, which must change the charge against this embryonic layer, and Rosenstein surmises "that the pathogenetic cause exerts its influence at a very early period of embryonic life, before any distinct differentiation (of embryological layers) has begun."

Delayed coagulability might be thought a factor, but instead it is ahead of normal time. That the pressure necrosis following the haemorrhage is at least an incentive to the bone formation would seem to be logical, inasmuch as calcification and ossification of necrotic tissue has been repeatedly observed in various organs.

Rosenstein compiled 120 cases in chronological order. The first was one reported by Guy Patin, in 1692, and his last was his own, which he reports in detail. Of these, however, he finds five were not true cases, and his list covers, therefore, 115 cases. This report adds fourteen new cases from the literature and my own case, which brings the total number of cases reported to 130. Our bibliography contains only verified

references. Of these 130, the sex was not stated in 8, and of the 122 remaining, 74 were males and 48 were females.

The age at which the first symptom was noticed is not given in 18 cases. In the rest it was two or under in 39 and under 10 years in 102. In only a very few cases is it noted as being present in relatives.

Case 1—Reported by Almond, G. H. H. Adenoids removed at 3½ years. Glands in left neck removed one year later. At 5½, swelling of ankle, which rapidly subsided. After this, stiffening of the hips, knees; ossification of the biceps of arms; of iliotibial band, hamstrings, etc. Ossification occurs in fibrous and connective tissues as well as in muscles. Great toes normal. In discussion, septic infection as etiology for this case was suggested.

Case 2. Reported by Andersen, K. Girl, 8, of healthy parentage, born with deformity of both thumbs and big toes. Swellings appeared in front of both ears and progressive trismus developed, with difficulty in swallowing. At the same time hard nodules formed in the masseter muscles on both sides. The swelling gradually subsided, but seemed to move on to the shoulders, where hard nodules now formed in the muscles. One of the swellings threatened to rupture through the skin, and was removed and found to consist of bone tissue. The stiffness and swelling showed alternate improvement and aggravation. General condition good, but there was well marked trismus so that the upper and lower teeth could not be separated; there was a small open-

ing just large enough for food to be introduced. Several hard bony nodules could be felt in masseter muscles, especially on the right. Shoulders greatly involved; both upper arms held in abduction; very slight flexion. On right side, bony masses in latissimus dorsi and the pectoralis major was indurated as a whole; on left, several isolated hard bony nodules were palpable. Other muscles in upper extremities normal.

Same case as Andersen's. Reported by Hoyer, S. Hoyer had previously rendered diagnosis unknown to Andersen. Hoyer extirpated the nodule, which was examined microscopically (there was no danger of skin rupture; extirpation was done simply for examination). Specimen was removed from one of the hardish and largest indurations from border of right latissimus dorsi and scapular angle. Microscopic diagnosis was fibromatosis, no ossification being demonstrated. Designation as "myositis" is incorrect; the Japanese investigator, Goto, accordingly calls the disease "Hyperplasia fascialis progressiva."

Case 3. Reported by Caronia, G. Girl, 4 years. Series of protuberances at nape of neck and in lumbar region. Active and passive movements greatly limited in neck, trunk and upper limbs. Slight microdactylia of thumbs and big toes; shortening of phalanges of little fingers.

During observation, protuberances became more pronounced, and others were found in the tendinous insertions of the biceps muscles of arms.

Various therapeutic measures—mercury, arsenic, antimony, iodine, thyrodine, adrenalin, thymic extract, hypophysin—proved inefficient.

CASE 4. Reported by Drago, A. Girl 8 years. Trouble began at about 4 years, after slight traumatism of right axillary region. A swelling appeared, then disappeared; the same occurrence took place then in other localities. Two months after onset pain in hip and dragging of foot followed. Radiography showed pectoral muscles sclerotic and retracted. Shadows corresponded to nodules of bony and cartilaginous character palpable in the muscular mass.

Shoulders seemed ankylosed, though the joints were intact. Microdactylia of big toes and thumbs.

CASE 5. Reported by Eiselsberg, A. Smallpox at 4, followed by stiffening in right elbow; at 14 years hardening had taken place; in 18th year a tumor below the shoulder-blade. Constant annoyance from hardening of right semimembranous musculature.

CASE 6. Reported by Grant, J. W. G. Girl of 4 years. Large irregular plates of bone in various tendons of erector spinae muscles and in the latissimus dorsi, pectoralis major, and teres major.

Peculiar deformity of thumbs and great toes, caused by absence of proximal phalanges.

Seventy-five per cent. of the recorded cases have shown such deformity, and it is quite probable that in the remaining 25 per cent. the condition escaped notice.

Although Grant operated with some success as regards position of the arms, he does not think the operation worth doing, as recurrence has followed in every recorded case.

CASE 7. Reported by Hill, M. C. Patient, boy of 12, presented. After 9 months of age, he had measles, whooping cough, and mumps, and at 2½, swelling of right side of neck, which has persisted and become progressively harder. Following this, muscles of back began to show areas of ossification, and also those of arms and legs. At present, boy presents many deformities—striking example.

CASE 8. Reported by Horand, R. Man, 36 years. Family history negative. Mother "delicate." Disease began in early youth, at 7. Patient had attacks of blood spitting—hemoptysis. The man stated that the trouble began at the top of his head, and followed the spine to the lower portion of the back, paralyzing both arms to the shoulders, the neck, and jaw. After a kick, the left leg was paralyzed, and after a fall, the right arm, which had been immobilized for 5 years, was broken. Then the other leg and other arm were in turn mobilized.

Patient is intelligent; bad general condition; much eczema; terribly thin; body covered with protuberances; shoulders stick out and are carried in advance.

"Une statue vivante qui a la notion d'equilibre." He is carried about like a block.

The masseter muscles are as yet not involved, but the patient can hardly use his teeth, since the inferior maxilla is fixed to the left sterno-cleido mastoid. There is a bony prominence between the cranial base and the vertebral column at the level of the spinal apophyses. The head cannot be turned; the sterno-cleido mastoid muscles are totally involved at the left. Both trapezius muscles are involved. Intercostal, pectoral, dorsal muscles involved. Arms and legs almost useless.

Visceral organs and organs of sensibility, blood system, and nervous system all appear normal.

Thyroids and parathyroids appear atrophied, a significant fact in relation to calcium metabolism.

Even in a few months' observation the general condition has become worse. The patient is becoming more and more petrified. His "carapace" continually crystallizing threatens to envelop him in a strong shroud.

CASE 9. Reported by Kohlhaas. Man, 44 years. Up to 12th year, patient had been well; he then began to suffer repeatedly, without a known cause, from attacks of pain and swelling in muscle groups. Examination showed that a large portion of the muscles of the neck, back, shoulders, upper arms, and thighs were involved. The jaws could not be opened; the neck was held rigid; the arms could not be moved in the shoulder-joints; elbow and knee-joints were likewise affected. The x-ray plates showed abundant evidence of ossification.

This man, a Roumanian, was presented by Virchow and others in the nineties, and later on utilized his deformity for commercial purposes. His case was written up by Virchow in 1894. See Rosenstein, p. 15, case xlvii.

CASE 10. Reported by Manuwald, A. Typical case. Girl 4 years. No faulty heredity. Microdactylia of thumbs and big toes. The author suggests Stempel's theory of imperfect differentiation of mesenchyma; the original germinal tissue under these pathological conditions retains the capacity of continued bone formation. This case presented the appearance of cervical spondylitis, but the vertebral column was intact. The sterno-cleido mastoid muscles were implicated; the muscles at the nape of the neck were diffusely swollen and board-like to the touch. The head was nearly fixed. The large pectoral muscles contained bony deposits.

CASE 11. Reported by Paterson, A. M. Showing of skeleton of recent case of myositis ossificans (progressiva?).

Almost complete ankylosis of vertebral column; atlas and coccyx alone being free. Ankylosis of lower jaw and extensive formation of new bone from left mandible, resulting after operation intended for relief of condition.

Many joints show arthritis; limb bones characterized by exaggeration of muscle attachments and irregular exostoses.

CASE 12. Reported by Stewart, W. H. Boy, 8 years. At 3½, whooping

cough and measles. After this, mass in neck, progressively becoming larger. Within week, limitation of motion; lumps in back; great weakness. Marked ossification of all muscles of back; ossifications present transverse ridges on either side. All shoulder muscles, biceps left arm, quadriceps left thigh, abdominal muscles, muscles of mastication and expression, and "those of the right" involved.

Stereo-roentgenographic examination reveals ossified ridges across back, involving all muscles.

CASE 13. Reported by Thomas, B. A.; Harrison, F. G. Girl, 4 years. Congenital malformation great toe. Measles; whooping cough. A fall, after which bump developed in back; later, child had chicken-pox. Lump in back grew larger and others appeared; limitation of motion of the spine, shoulders, and hips. Evening rise of temperature; no cough; Wassermann negative. Mother tuberculous.

CASE 14. Reported by Thompson, T. Man 43 years. At 8 years, shoulder became swollen and painful. At 16, pain and swelling at bottom of back. At 28, left leg and thigh became stiff. Arm later affected. Most of the muscles are infiltrated with hard, bony growths, so that his back is perfectly rigid. Masseters infiltrated with bone, and jaw is fixed. Deformity both great toes.

Pathological report (Turnbull) on portion of muscle (right pectoralis major) near calcareous area and a portion of tendon and hard, white bony substance.

This patient was one of the subjects in an investigation (Spriggs, unpublished) of metabolism of creatinin and uric acid in "some diseases of the muscles." The disturbance in creatinin excretion was not great.

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# News Notes

The Shriners' Hospital Unit, which started its work for the relief of crippled children in Honolulu the first of this present year, examined, for diagnosis and classification, during the month of January, ninety-six cases, of which twelve were refused admission to the Hospital on account of mental deficiency.

The remaining 84 were classified as follows:

Infantile paralysis, 37; tuberculosis, spine, 4; tuberculosis, hips, 8; spastic paresis, 11; club foot, 7; obstetrical paralysis, 3; rachitic bow legs, 2; congenital flat foot, 2; congenital hip, 2; polydactylism, 1; torticollis, 1; contracted hand (traumatic), 1; osteomyelitis, 1; ankylosis, elbow, 1; unclassified, 3. Thirty patients were admitted to the wards.

Dr. Hatt, who is in charge of the Unit, says that there are fifty crippled children now on the waiting list for admission to the Clinic, and that the early estimate of one hundred fifty crippled children on the islands has now been revised to four hundred.

A new thirty-bed ward and an operating room are under construction, and the people of the Island are offering splendid coöperation in the work.

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On February 2, 1923, a number of orthopaedic surgeons of Chicago met at the University Club of Chicago and formed an organization, taking the name of the Chicago Orthopaedic Club.

Dr. John Ridlon was elected President, Dr. Edwin W. Ryerson, Vice President, and Dr. H. B. Thomas, Secretary and Treasurer.

The following men were present: Dr. John Ridlon, Dr. H. B. Thomas, Dr. Charles M. Jacobs, Dr. Philip Lewin, Dr. C. A. Jacobson, Dr. S. C. Woldenberg, Dr. J. P. Sprague, Dr. Frank G. Murphy, Dr. M. Bernstein, Dr. T. J. Sullivan, Dr. J. Myers, Dr. E. W. Ryerson, Dr. E. J. Berkheiser, Dr. F. C. Test, Dr. B. H. Moore, Dr. G. H. Musselman, Dr. R. O. Ritter, Dr. D. F. Clark, Dr. E. B. Fowler.

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The winter meeting of the Interurban Orthopaedic Club was held in Montreal on January 19 and 20, 1923.

On the first day the following programme was presented at the Children's Memorial Hospital:

1. A Discussion on the Calcification of Tuberculous Lesions in Children with an Illustrative Case. To be opened by Drs. Lawrence J. Rhea and Mackenzie Forbes.

2. A Discussion on Poliomyelitis. (a) Pathological Lesion, to be opened by Dr. Lawrence J. Rhea. (b) Early Diagnosis and Treatment, to be opened by Dr. H. B. Cushing.

3. Lantern Slide Demonstration of (a) Melanotic Sarcoma of the Eye with Metastases; (b) Congenital Tumor of the Kidney; (c) Congenital Tumor of

the Ovary in a Child Seven Months Old with Precocious Sexual Development, Operation and Recovery. To be presented by Dr. Lawrence J. Rhea. Discussion to be opened by Colonel Kenneth Cameron, Drs. H. B. Cushing, R. Kerry, Lionel M. Lindsay and H. Rupert Derome.

4. A Case of Dystonia Lenticularis. To be presented by Dr. H. B. Cushing. Discussion to be opened by Dr. A. A. Robertson.

5. A Discussion of the Rheumatoid Conditions. (a) Pathology, Dr. Lawrence J. Rhea; (b) Etiology, Classification, etc., Dr. H. B. Cushing; (c) Biochemistry, Dr. I. M. Rabinovitch; (d) Treatment, Dr. Mackenzie Forbes.

6. The Life History of a Child, Illustrating the Development of Rickets. To be presented by Dr. H. B. Cushing. Discussion to be opened by Dr. Alton Goldbloom.

7. A Discussion of the Physiological Principles Involved in the Transplantation of Muscle. (a) Presentation of Two Cases, Dr. Mackenzie Forbes; (b) Neuro-Physiological Aspect, Dr. A. A. Robertson.

8. A Discussion of the Various Stages of Pyogenic Osteo-myelitis. To be opened by a Discussion of the Clinical Features and a Lantern Slide Demonstration of the Concurrent Changes in the Bone, Dr. Mackenzie Forbes.

9. Congenital Abnormalities of the Bones. A Series of Cases to be presented by Dr. F. P. Yorston.

10. Open Air Treatment of Diseases. Inspection of a New Self-contained Hut.

The meeting of the second day took place at the Royal Victoria Hospital, where the programme was as follows:

Tuberculosis of the Knee-joint, Dr. W. J. Patterson.

Gall Bladder Drainage—Interpretation of Results, Dr. R. H. M. Hardisty.

(a) Intertrochanteric Fracture of Femur. (b) Hip Cases, Dr. W. G. Turner.

Pathological Conference, Professor Oertel.

Unusual X-Ray Cases, Dr. Pirie.

Delbet Method of Treating Fractures of the Tibia and Fibula, Dr. Alex. Fraser.

(a) An Unusual Fracture, "Marble Bone." (b) Hospital Records, Dr. C. B. Keenan.

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The Section in Orthopaedic Surgery of the New York Academy of Medicine met on Friday evening, Dec. 15, 1922. The following cases were reported:

(a) Open Reduction for Congenital Dislocation of the Hip, Herbert A. Durham, M.D.

(b) A Case of Rachitic Scoliosis; X-Rays.

(c) Scoliosis Due to Empyema. X-Rays. Nathaniel Mills, M.D. (By invitation).

(d) Two cases of Sprengel's Deformity, Treated by Operation, Herbert Taylor, M.D.

PAPERS.

(1) Pathological and Clinical Studies and Observations following Operations for Spine Fusion. Alan De Forest Smith, M.D. (By invitation.)

(2) Lumbo-Sacral Region; an Anatomical Study, and some Clinical Observations. Herman L. Von Lackum, M.D. (By invitation.)

On Friday evening, January 19, 1923, the programme was as follows:

PRESENTATION OF CASES. (From the Hospital for Ruptured and Crippled.)

(a) Result obtained in the treatment of epiphyseal separation, neck of both femora. Lantern Slides.

(b) The result of transplantation of tibialis anticus for paralysis of peroneal tendons.

(c) Unusual fracture of the shaft of the femur in a child. Lantern Slides. Charlton Wallace.

(d) Report of a case of recurring tuberculous abscess, rupturing into the bladder. Brainerd H. Whitbeck.

(e) Periosteal chondro-sarcoma of the tibia.

(f) Unusual injury of the patella. Samuel Kleinberg.

(g) Case of subcapital fracture of neck of the femur. Armitage Whitman.

(h) Tendon transplantation for irreparable injury to the posterior interosseous nerve.

(i) Secondary Os Calcis. Arthur Krida (by invitation).

(j) Healed fracture of the spine. Irving Balensweig (by invitation).

(k) Fracture-dislocation of the wrist. Neil G. Rosén (by invitation).

(l) Result of operation for ruptured quadriceps extensor.

(m) Unusual fracture of elbow. Isidore Zadek.

(n) A new method for reducing congenital dislocation of the hip—demonstration of a new instrument.

(o) A new bed traction apparatus; lantern slides. Percy W. Roberts.

PAPERS OF THE EVENING.

(a) "The Relation of Congenital Syphilis to Lesions of Bones and Joints." Percy W. Roberts.

(b) "Arthroplasty of the Knee." Illustrated by lantern slides. Willis C. Campbell of Memphis, Tenn. (by invitation).

The Section also held a meeting on Friday evening, February 16, 1923, with the following programme:

PRESENTATION OF CASES AND CASE REPORTS.

(From Mount Sinai and Montefiore Hospitals.)

(a) Report of three cases of spondyloarthritis of the atlas (x-ray demonstration) (1) due to actinomycosis; (2) dysenteric; (3) of unknown etiology.

(b) End-results in congenital dislocation of the hip.

(c) End-results in fracture of the neck of the femur.

(d) End-results in delayed union following fracture of the tibia. P. William Nathan.

(e) Aplasia.

(f) Metaplastic osteitis, with multiple fractures. Edgar D. Oppenheimer.

(g) Pathological fracture of the humerus. Sigmund Epstein.

PAPER OF THE EVENING.

"Loose Bodies in the Joints and Bursae Due to Synovial Osteochondromatosis." Melvin S. Henderson, Mayo Clinic, Rochester, Minn. (by invitation).

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The twenty-fifth anniversary of the Netherlands Orthopaedic Association will be held at Amsterdam on May 25th and 26th, under the presidency of Dr. Murk Jansen. The occasion will be a noteworthy one, and many celebrated orthopaedic surgeons will contribute to the success of the meeting. Among the invited guests are Professor Putti of Bologna, Professor Spitzy of Vienna, Professor Biesalski of Berlin, Dr. Cabot of Berck Plage, Sir Robert Jones of Liverpool, and Dr. Brackett of Boston.

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It is with much regret that we announce the death of Dr. L. Bruce Robertson, of Toronto, which occurred on February 24th, following a brief illness with pneumonia.

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The Thirty-seventh Annual Meeting of the American Orthopedic Association will take place in Rochester, New York, on June 7th and 8th, 1923. Professor

Denucé, of Bordeaux, will be present as the guest of the Association, and will present a paper on his method of treatment of congenital dislocation of the hip. Dr. R. R. Fitch will preside at the meetings.

The headquarters of the Association during the meeting will be at the Sagamore Hotel on East Avenue, and the sessions will be held in the Genesee Valley Building, on the corner of East Avenue and Gibbs Street, which is nearly opposite the hotel.

It is expected that the members of the Association and their guests will have an opportunity to hear the following papers:

The Pathological Changes in Tissues secondary to Disturbances in Circulation—Dr. Barney Brooks.

Old Congenital Dislocations of the Hip. Operatic Treatment—Dr. Frank S. Dickson.

Observation on Arthritis—Dr. Loring T. Swaim.

Review of Infantile Paralysis After the Acute Stage—Dr. Arthur T. Legg.

Non-suppurating Osteomyelitis—Dr. M. S. Henderson.

Arm-Chest Adhesions—Dr. John Staige Davis (by invitation).

Recurring Lateral Dislocation of the Patella—Dr. William E. Gallie.

Patellapexy—Dr. Walter G. Stern.

Z-Plastic Surgery—Dr. Stewart L. McCurdy.

Origin and Changes of Loose Bodies in Joints—Dr. Dallas B. Phemister.

A Report of the First Forty-Five Cases of Scoliosis Treated by Fusion at the New York Orthopaedic Hospital—Dr. Russell A. Hibbs.

The Treatment of Compression Paraplegia of Pott's Disease—Dr. Charlton Wallace.

Anatomical Study of the Spine with Reference to Structure and Symptoms—Dr. Joel E. Goldthwait.

Some of the Causes of Low Back Pain—Dr. Murray S. Danforth.

Compound Fractures of the Femur and Open Fractures into Joints—Dr. William O'Neill Sherman (by invitation).

Simple Fractures of the Femur—Dr. Arthur M. Shipley (by invitation).

The Late Correction of Fracture Deformities of the Femur—Dr. H. Winnett Orr.

After-Care of Fractures from an Industrial Standpoint—Dr. Edwin W. Ryerson.

An Operation for the Correction of Plantar and Adduction Contraction of the Foot Arch—Dr. J. T. Rugh.

Operation for Drop Foot with Report of Cases—Dr. Willis C. Campbell.

The Author's Operative Method for the Correction of Hammer Toe—Dr. Robert E. Soule.

The Problem of Orthopaedic Surgery in China—Dr. E. G. Brackett.

On June 5th, two days preceding the regular meeting of the Association, for those members who wish to take advantage of the opportunity, there will be a Clinical Day held in Montreal. Arrangements for the day are being made by Dr. A. Mackenzie Forbes and Dr. W. G. Turner, and clinics will be held at the Children's Memorial Hospital and the Royal Victoria Hospital. Wednesday, June 6th, will be devoted to a trip by water through the Thousand Islands and Lake Ontario to Rochester, N. Y., which will be reached in the evening.

The fare from Montreal to Rochester is about fifteen dollars, including luncheon and dinner. Unless "Circular Tour" tickets are available from the city of residence, transportation should be taken to Montreal, and from there to Rochester, N. Y., by the Canada Steamship Company. If a sufficient number of the members of the American Orthopedic Association decided to go this way a reduction in the fare will be made.

It is hoped that a large number of the members of the Association will avail themselves not only of this most beautiful trip by water, but also of the Clinical Day to be held in Montreal. Further information may be obtained by writing to Dr. A. Mackenzie Forbes, Children's Memorial Hospital, Montreal.

# Book Review

*Orthopedic Surgery.* By Sir Robert Jones, K.B.E., C.B., and Robert W. Lovett, M.D., F.A.C.S. New York: William Wood & Company, 1923.

This new volume, the production of internationally known authors, writing from opposite sides of the Atlantic, represents the most instructive and comprehensive survey of the field of orthopaedic surgery yet attempted. It is the first time, so far as we are aware, that the adults' and children's phases of the work have both been properly presented in the light of recent progress. Modern literature has been carefully searched, and nothing that represents a definite advance, particularly in the operative field, has been omitted. References are made to fundamental articles, and the conscientious effort to credit work in each instance to the proper individual is exceedingly praiseworthy.

In providing the best text book yet obtainable for students, the approach to the various subjects is made in an original manner which avoids the orthodox method of considering each subject piecemeal without reference to related subjects, then dismissing it, and proceeding with the next. After first building up a solid foundation of fundamentals with a review of the anatomy, physiology, and pathology of the subject under discussion, the various topics are considered along broad general lines. Disease is considered as a reaction to unfavorable conditions, symptoms as clinical manifestations of pathological conditions, and treatment is discussed from the standpoint of meeting pathological requirements. This does not prevent the consideration of the various subjects from being meticulously detailed. This original method of approach, combined with the delightful literary style of the writers, makes the book easy and delightful reading, and will win for it many friends.

The main purpose of the book, however, is not as a text book, but as a guide to the general surgeon and practitioner, who, because of a limited experience in the conduct of so-called orthopaedic conditions, too often feel entirely helpless when confronted with a case requiring actual assistance. To them this book will prove a real delight. The encyclopaedic method is entirely lacking, and the authors' opinions are definitely expressed in every instance, and methods which they consider unsound or obsolete are completely omitted. Debatable matters are handled sanely with a consideration of both sides, but one is not left wondering as to which side the authors' opinions incline. Reference to the book with a case in mind more nearly approaches a consultation with the authors than is the case with any other book on the same subject. It was to be feared that widely divergent opinions of the writers on certain subjects might lead to compromise and lack of force, but so far as we can see this fault has been avoided.

From the standpoint of interest in a field of orthopaedic surgery that is constantly growing in importance—namely, the work dealing with the correction of faulty mechanics of the body—we cannot help wishing that some attention had been devoted, but perfection means different things to different persons, and certainly the reader, whoever he be, will find each of the 700 pages of this book teeming with interest, and its 712 illustrations clear cut and of valuable aid in explaining the text. The book represents a very notable achievement.

# Current Orthopaedic Literature

## TUBERCULOSIS.

ANKYLOSING OPERATIONS IN THE TREATMENT OF POTT'S DISEASE IN THE ADULT. DISCUSSED BY DR. ESTOR. *Presse Médicale*, Oct. 14, 1922.

This question, one of three taken up at the Fourth Congress of the French Orthopaedic Society (Paris, October 5, 1922), was discussed by Prof. Estor of Montpellier.

His conclusions were (1) that it was not indicated in children, but was logically employed in the adult, without, however, replacing a prolonged immobilization, usually three years; (2) the operation has given good results and should meet with greater favor in France; (3) the graft undoubtedly lasts strongly for some time; (4) the Albee method is one most generally adopted; (5) a bone graft influences favorably abscess formation, nervous complications, and pain, but he does not think it can have an influence in reducing the deformity.

Dr. Putti of Bologna did not evidence any enthusiasm over ankylosing operations, though recently returned from America. He preferred the Hibbs to the Albee operation.

Dr. Delchef of Brussels wished to know why children should not also be operated on, and emphasized the necessity of operating early.

Dr. Etienne Sorrel of Paris advised that ankylosing operations should be reserved for adolescents or adults in a late period of the disease. He recommended Albee's instruments as the best.

Dr. Lance of Paris spoke favorably of the Hibbs' operation, especially since he had used it in cases of paralytic scoliosis.

Dr. Mauclaire of Paris held that ankylosing operations should be used only in cases of advanced bone destruction. In dorso-lumbar and lumbar cases it was unnecessary and in cervico-dorsal or high dorsal cases it seemed to lead to meningitis and was, therefore, contraindicated.

Dr. Patel of Lyons reported a successful cure in a woman of thirty-five, brought about by an ankylosing operation.

Dr. Charles Martin du Pan of Geneva spoke favorably of heliotherapy and quoted successful cases in children who had had grafts.

Professor Estor closed the discussion.—*J. A. Nutter, M. D., Montreal.*

DISEASE. G. R. Girdlestone. *British Journ. of Surg.*, January, 1923, p. 372.

From a consideration of the nature of operative treatment of Pott's disease it is obviously not a short cut in treatment, nor should it be expected to replace the general hygienic measures which are always necessary in case of tuberculosis, no matter how far localized. It is of value only as a part of the conservative treatment of Pott's disease. The general indications for treatment are, first, raise the general level of health and increase the patient's resistive powers; second, obtain healing of the spinal lesion with re-establishment of sound structural stability.

Albee's operation apparently developed as an outgrowth of Brackett's observation that normal healing in Pott's disease was frequently accompanied by fusion of the posterior spinal arch. Albee wished by his graft to anticipate this fusion before the development of deformity. Hibbs stressed the necessity of eliminating all motion, feeling that this would hasten cure.

When the spine is considered from the standpoint of statics, it is obvious that the body is a weight-bearing portion, the spinous processes and transverse processes are the levers by which movement is obtained, and that under these circumstances the spinal articulations serve as fulcra to provide the means of securing leverage. Caries of the spine is accompanied by (1) telescoping, (2) inflection, with deformity.

The objective of spinal fixation and its rationale are to hold the weight-bearing portions or bodies apart by drawing the spinous processes together. It is essentially a splinting procedure; it is not intended that the union should resist cross breakage strain. The chief strain exerted is one of tension, so that there is not necessarily a comparison between the weight of the body and the strength of the graft.

Girdlestone reviews the various methods of operation and concludes that Albee's operation is successful in a large number of cases and is essentially less difficult than the Hibbs procedure. He has had no personal experience with the Hibbs operation and, although the reported results are excellent, he feels that the technique is difficult and the operation time-consuming, and that it would be necessary to spend considerable time at Hibbs's clinic to acquire the technique. He compares his own results in a hundred cases with Hibbs's reports of results in 210 cases.

Hibbs—210 cases. Cured, 157; op. mort., 0; doubtful, 22; dead, 31. 13 died miliary tuberculosis; 5 of tuberculous meningitis; 4, phthisis; 3, amyloid disease.

Girdlestone—100 cases. Op. mort., 2; later mort., 6. All but one died of tuberculous compl.

End-Results—First 50, 1914, 18. Well, 42; last heard of well, but no recent report available, 5; with signs of persistent or recurrent disease, 4; dead, 8.

Last 41, 1919, or later. Healed and O. K., 36; psoas abscess but O. K., 1; with signs of persistent or recurrent disease, 4; dead, 0.

*After-Treatment.* The frame fixation was at first used for three months only, but in the case of children it has since been extended to six months. In the case of adults four months is sufficient, and the spinal support is worn for one year following this, and generally anti-tuberculous measures are employed. He feels an essential and important part of the after-treatment is the use of

an anterior plaster shell, which is used as a turning case, the patient being allowed to lie on that whenever the back is inspected, the back dressed, and heliotherapy employed. This is made before operation, and during operation the child is supported in it, a frame being built out to support the forehead and allow the easy administration of anaesthetic.—*P. D. Wilson, M.D., Boston.*

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EARLY DIAGNOSIS OF JOINT TUBERCULOSIS. A. Krecke. *Muench. Med. Woch.*, Sept. 29, 1922.

The absence of early characteristic signs of tuberculosis of joints frequently leads to wrong diagnosis and hence to inefficient therapy. Careful and repeated examinations, however, with due consideration of subjective and objective findings, must result in a proper diagnosis even in the early stages.

The patient complains of weakness and fatigue in the affected extremity. Parents of small children will state that the patients spare the affected parts, not using the arm or not carrying the full weight on the affected leg. Only after the lapse of some time will pain be complained of in the joint in question itself or in remote joints of the extremity, this pain being augmented, as a rule, after exertion. The objective findings should be gathered from an inspection of the patient entirely stripped. The affected extremity should be carefully inspected and compared with the unaffected limb. It is important at this time to carefully study the normal depressions and elevations recognizable about each joint. This is followed by exact comparison of both sides with the aid of a tape measure. Muscular atrophy above and below the joint is determined and seriously considered. The determination of active and passive motion of the suspected joint and the comparison of these findings with the normal side follow next. All movements are recorded by means of a goniometer. In passive motion the manifestation of pain at the termination of a completed movement, flexion, extension, ab- or adduction, inward or outward rotation, is always suspicious and must be noted carefully. Frequently the pain is accompanied by muscular spasm after this passive maneuver. The radiographic findings, although they are to be obtained, are not indicative of a tuberculous process in a joint. Very rarely will any change be noticed in the early stage. The general health of the patient must be considered, other organs, especially enlarged glands, examined, and the afternoon temperature for a number of days determined. The tuberculin reactions, intracutaneous and intramuscular, must be administered, although a negative result is not to be regarded as excluding a possible tuberculosis of the joint.—*A. Gottlieb, M. D., Los Angeles.*

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DIFFERENTIAL DIAGNOSIS OF INCIPIENT TUBERCULOUS SPONDYLITIS AND CHRONIC RHEUMATISM OF THE BACK MUSCLES. C. Mau. *Muench. Med. Woch.*, September 29, 1922.

Contrary to the deliberations of Pitzen in a recent article in the above journal concerning the uselessness of tuberculin reactions in a differential diagnosis of the two above-named affections, the author insists that tuberculin tests are by all means to be considered in the differential diagnosis of these

diseases. He values the reactions especially when, besides the Pirquet, the intracutanous reactions prove negative, and when with a positive Pirquet, the temperature reaction, after subcutaneous injections of higher doses of tuberculin, remains negative. Spondylitis can then with certainty be ruled out. A positive temperature reaction plus a negative Pirquet, will not offer the surety that tuberculosis is absent, because a negative local reaction is not a guarantee against tuberculous infection. The statement that in spinal tuberculosis local reactions are more seldom seen than in other bone tuberculosis, the author contradicts on the basis of his accumulated material.—*A. Gottlieb, M. D., Los Angeles, Calif.*

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## CONGENITAL DEFECTS.

A Simple Method of Treating Club Foot (Congenital Talipes Equino Varus). A. S. Blundell-Bankart. *British Med. Journ.*, December 9, 1922, p. 1115.

This method will be quoted in some details, as the article contains little more than the necessary description to be clear.

The deformity is corrected in the ordinary way by tenotomy, manipulation and splinting, plaster of Paris or other retaining material being applied for a week or two or even much longer when desired. Then comes the special "fixation operation," which consists of a silk ligature extending subcutaneously from the base of the fifth metatarsal bone to the lower third of the tibia, where it is fastened by being passed through holes bored in the latter bone and tied. This the author claims secures the foot against relapse and shortens greatly the course of brace or plaster treatment. The silk is passed through a hole in the base of the fifth metatarsal and brought around its outer side, where it is tied in a single knot. From this small incision a probe with an eye at the tip is passed up the leg subcutaneously to the lower third of the tibia where, through a second incision, a drill bores two holes through the tibia to its inner side, to come out through a third small incision. By a succession of loops in the eye of the probe the two ends of the silk ligature are successively brought from the foot up the leg and through the separate holes in the tibia and tied on its inner surface. The wounds are closed, later the stitches removed, and then two months in plaster, after which the ordinary shoe is used. This is certainly interesting, if it is only effective.—*C. A. Parker, M. D., Chicago.*

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Spina Bifida Occulta and Its Sequels. M. Hackenbroch. *Muench. Med. Woch.*, August 11, 1922.

The extensive literature on this subject during the last few years is enriched through this article by the report of operative findings and evident therapeutic success on a patient, a girl of 12 years of age.

Case history: Healthy family, healthy brothers and sisters. Since three years of age progressive crippling of feet. Since ten years of age considerable growth of foot deformity. Since childhood enuresis nocturna.

Findings: Normally developed child. Negative findings except those on the

spine and feet. At about the last lumbar vertebra, along the line of the spinous process, a tumor mass of 7 cm. long, 4 cm. wide, and 1.5 cm. high, palpable under the skin. The consistency was that of a doughy swelling, with possible fluctuation. The skin was movable over the mass, which seemed to be adherent to a bony base. On each side of the swelling the palpating finger could feel a projection similar to a spinous process. In the region of the third lumbar, above, and the second sacral, below, a depression was felt. No loss of normal sensations and no tenderness present. All reflexes normal.

The lower extremities presented outspoken claw and cavus feet. Up to the middle of the calf, the legs were cold and somewhat cyanotic. Passive dorsal flexion met with spastic resistance. X-ray revealed a gap along the third to fifth lumbar and first to third sacral vertebrae. Operation under general anesthesia. Incision over the last lumbar. On the place of the swelling a muscle appeared which on all sides was constrained in the tense spinal fascia. It gave the impression of normal muscle tissue. Above this the vertebral canal was opened and the process of the fourth lumbar resected. The exposed dura was firm, 1 mm. thick, and adherent to the vertebral arches by means of fibrous bands. After loosening the fibrous bands, the muscle mass was carefully dissected from its base. On each side of this mass appeared a kind of spinous process between which it lay imbedded and it was connected in the median line by a bone-like tissue. The mass was resected in its entirety. After this a lipoma appeared on the dura, the size of a cherry, enveloped in a thin connective tissue membrane, adherent to the dura and the vertebra. Closure of muscle and skin.

One hour after the operation, the livid appearance of the feet disappeared. Both feet and legs became normal in color and temperature. Primary union. Since the day of the operation the enuresis nocturna has been absent. The foot correction was performed one month later.

The findings of this case demonstrate: 1. Spina bifida is to be regarded as primary fetal malformation and not as resulting, secondarily, from an intrauterine disease process. 2. The difficulty of differentiating it from a meningo and myelocele.—*A. Gottlieb, M. D., Los Angeles, Calif.*

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CASE OF OSTEOGENESIS IMPERFECTA. M. F. L. Keene. *Lancet*, September 23, 1922.

The case was that of a stillborn female child at the end of an eight-month pregnancy. The extremities as described and shown in the illustrations were very short and deformed. "The shaft of the long bones showed a fibrillated periosteum ruptured in places and containing a pulpy mass consisting of minute islands of osteoid tissue, marrow and osteoblasts, in very large number."

The subperiosteal bone was absent. There were feeble attempts at ossification in the membranous cranium and the ribs were entirely cartilaginous. The small size of the thymus was suggested as a factor interfering with bone development.—*C. A. Parker, M. D., Chicago.*

## FORMS OF ARTHRITIS.

NON-TUBERCULOUS ARTHRITIS OF THE HIP. A. Broca. *Presse Médicale.* November 1, 1922, p. 941.

The writer points out that all hip arthritides center on the possibility of tuberculosis, and that not only are there numerous non-tuberculous arthritides, but tuberculosis itself varies in its intensity—whence the difficulty of diagnosis. He attaches little importance to the tuberculin reaction, save when negative. 1. In speaking of caput planum (Legg-Calvé), he does not think it due to malformation of the acetabulum, nor to trauma, there being no history of this in his 10 cases. 2. Speaking of mild cases of arthritis with a limp, he insists that it is impossible to differentiate these at once from tuberculosis, and points out that even tuberculosis may present intermittent periods of freedom from symptoms. He advocates in doubtful cases two weeks' rest in bed and two weeks on the feet. If signs still persist we know that a chronic arthritis is present, of which tuberculosis is the probable cause. Of the non-tuberculous cases, some may be "growing pains," others luetic, and others may turn out to be caput planum. 3. Sudden dislocation, almost always iliac, is special to the hip. It is sometimes preceded by an acute arthritis, and the x-ray may show no bone lesion. It should be reduced at once. This may be due to tuberculosis, typhoid, influenza, or to an osteomyelitis. Another lesion due to osteomyelitis is separation at the epiphyseal line, the head remaining in place, the neck dislocated upward. 4. In acute arthritis the difficulty is to decide whether pus is present. The general signs and the use of an exploring needle help to differentiate this from an acute rheumatism. Acute suppurative arthritis, the result of osteomyelitis, should be treated by resection of the femoral head for drainage, whether the head be infected or not. It is frequently seen in nursing infants and is generally very severe when caused by staphylococcus or streptococcus, but benign when caused by the pneumococcus, which type of infection is happily more frequent. Free drainage is necessary. 5. In speaking of chronic hip arthritis suspected of tuberculosis, but without definite proof, Dr. Broca says we know little of syphilis of the hip. He notes, however, that bilaterability, a sign of syphilis in the knee, is here often a sign of tuberculosis in hip conditions. In discussing caput planum, he evidently holds that some cases, at least, are tuberculous in origin. He notes three cases of caput planum following chickenpox, with complete restoration of the structure and function of the hip. 6. In closing, he speaks at length of the difficulty of differentiating between tuberculosis and osteomyelitis, quoting a case in point, where the latter disease finally made its presence certain by the discovery of a typical focus, with sequestrum, in the humerus. He speaks of rapidly spreading tuberculosis which simulates tuberculosis and of a differential diagnosis between tuberculosis and non-suppurative osteomyelitis, with x-rays giving no assistance, made by the aspiration of a few drops of sterile fluid. He has made his diagnosis in general by watching the case for years, when the presence of a cold abscess or of a sequestrum has cleared up the diagnosis.—*J. A. Nutter, M.D., Montreal.*

NEUROPATHIC ARTHRITIS. John H. Duncan. *Jour. Amer. Med. Assn.*, December 9, 1922, p. 1987.

When any nervous structure is injured by trauma, infection, or toxins, reflex arcs are disturbed, the permanency of the condition depending on the cause. Skiagraphs of teeth showing absorption, clubbing of roots, and hypertrophy in a patient who suffered the removal of the Gasserian ganglion are shown. When the efferent nerves are destroyed the result is atrophy, but when the afferent nerves are destroyed the result may be either atrophy or hypertrophy.

A case showing injury to afferent nerves is described where a log had fallen on the patient's right shoulder.—*Edward S. Hatch, M.D., New Orleans.*

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UNUSUAL CASE OF STILL'S DISEASE. H. Schneiderman. *Missouri State Med. Assn. Jour.*, November, 1922.

Still was the first to describe a type of rheumatoid arthritis in children characterized by a progressive enlargement of the joints, lymph glands, and spleen. The onset is usually before six years. The progress is slow, with stiffness of one or more joints. There is a gradual enlargement with thickening of tissues. The enlargement is not bony. There is no effusion or suppuration. Limited motion, rigid flexion, but no ankylosis of joints. Muscle atrophy is present. The glands next the affected joints become enlarged. The prognosis is fatal.

The author discusses a case, age 15 years, which gave the chief complaint of blindness, deafness, and tremendously enlarged lower extremities. The personal and family history were negative. At the age of six years the left knee began to enlarge without fever or other systemic disturbances. The other joints began to enlarge until the age of 11, when all joints of upper and lower extremities were enlarged and rigidly flexed. October, 1920, lower extremities from knees to toes began to swell. Lost hearing; then few months after she lost her sight. Heart showed great enlargement. There was a systolic murmur at the apex. All the joints of the upper limbs were enlarged, tender, and rigidly flexed. The legs gave the picture of elephantiasis and were covered with foul-smelling ulcers. The blood picture was one of secondary anemia. The blood and spinal Wassermann were negative. The x-ray examination showed thinning of the bone shafts, enlargement of the heads of the bones, with thickening and calcification of the soft parts around the joints. The legs were amputated above the knee on account of the necrotic condition of the soft parts. The autopsy findings were important in that there was no evidence of tuberculosis or syphilis.

The author points out that his case resembles Still's description, aside from the unusual feature, namely, elephantiasis.—*Voigt Mooney, M.D., Pittsburgh, Pa.*

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CHRONIC NON-TUBERCULOUS ARTHRITIDES OF THE HIP IN CHILDHOOD. (Third question discussed at the Fourth Congress of the French Orthopaedic Society.) Dr. Etienne Sorrel. *Presse Médicale*, October 14, 1922.

Dr. Sorrel described: (1) hemophilic arthritis; (2) traumatic arthritis following fractures, coxa vara, coxa valga, and congenital dislocation; (3) arthritis accompanying infectious diseases, as pneumonia, scarlet fever, smallpox, measles, typhoid, syphilis, gonorrhea, osteomyelitis; (4) dry arthritis deformans, more frequent in adolescence than has been thought; (5) osteochondritis deformans (Legg-Calvé).

On this latter subject Dr. Sorrel spoke at length. It had been suspected by Kirmisson and others before it was discovered and given a name by Legg of Boston and later by Calvé (Berck) and Waldenström, the latter considering it tuberculosis of the neck of the femur. It is generally seen in boys of five to nine years and is rarely bilateral. Its pathologic anatomy is little known and almost wholly through x-rays. The epiphyseal disc is flattened and may be fragmented; the femoral neck is often thick; coxa vara, as a rule, is not present. The onset is insidious, with pain and limp on walking. Its course is benign, leading neither to ankylosis nor to arthritis deformans. As to cause, Legg's traumatic hypothesis is not proved. Is it congenital? (Murk Jansen.) Sorrel thinks it is inflammatory in origin, but cannot indicate the source. The endocrine glands have been thought the cause, as with inflammation of the scaphoid bone of the foot, and hereditary syphilis has also been considered.

Dr. Nové-Josserand (Lyons) discussed the relationship of osteochondritis with arthritis deformans juvenilis and with coxa vara. He thinks them all forms of the same disease, with different anatomic aspects.

Dr. Froelich of Nancy described: (1) dry progressive arthritis with congenital hip dislocation; (2) arthritis with progressive deepening of the acetabulum; (3) osteochondritis (Legg-Calvé), which latter is a form of epiphysitis, together with essential coxa valga.

Dr. August Broca (Paris) deplored the vague term coxalgia as leading to confusion. He thought that some cases of osteochondritis (Legg-Calvé) were of a tuberculous nature.

Drs. Albert Mouchet and Carle Roederer make no distinction between osteochondritis and osteoarthritis in childhood, thinking them probably identical.

Dr. André Rendu (Lyons) reported cases of osteochondritis following trauma and one case following rickety deformities.

Dr. Vignard (Lyons) told of arthrotomies in two cases of osteochondritis. From one he removed two small fragments of bone of ivory hardness resembling sequestra. In the other case nothing particular was found. Dr. Vignard considered these cases showed plainly that osteochondritis was neither due to an incomplete hip dislocation nor to a congenital deformity of the acetabulum.

Dr. Judet (Paris) divides non-tuberculous hip arthritides into: (1) traumatic, (2) congenital abnormalities, (3) essential coxa vara, (4) those due to infections, (5) those of unknown origin, possibly due to hereditary syphilis or an attenuated tuberculosis.

Dr. Lance maintained that osteochondritis could lead to permanent deformity, as opposed to Dr. Sorrel's opinion that it never did so. He was also impressed by the rôle of congenital syphilis as a causative agent.

Dr. Kirmisson spoke of the relationship of coxa vara with adiposity and thyroid insufficiency.

Dr. Froelich of Nancy thought the epiphysitides of the period of growth were due rarely to trauma, but generally to systemic infection, with or without the influence of the endocrine glands.—*J. A. Nutter, M.D., Montreal.*

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## SCOLIOSIS.

OPERATIVE TREATMENT OF SCOLIOSIS. Samuel Kleinberg. *Arch. of Surgery.* November, 1922.

Nineteen cases of structural scoliosis between the ages of eight and twenty have been operated upon by the author in the last two years. Treatment consists of: (1) the preoperative stage, consisting of four to eight weeks' recumbency and stretching of the trunk on a gas-pipe frame; (2) the operation, which is a combination of certain features of the Hibbs, Albee, and Forbes ankylosing operations, using a beef bone graft; (3) the postoperative stage, consisting of ordinary recumbency in bed for a week, then replacing on the frame with traction, as before, for about eight weeks, followed by an ambulatory jacket for several months.

Conclusions are that this method is a distinct improvement in the management of this troublesome condition; that the beef bone graft has many advantages and has not had to be removed in any of his cases, probably because of especially careful preoperative preparation; that the maximum possible correction of the deformity is quickly obtained by the preoperative management and can probably be permanently maintained by the operation and the comparatively short period of after-treatment. However, it will require several years for final proof of this.—*R. W. Billington, M.D., Nashville.*

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SCOLIOSIS. Alexander MacLennan. *Brit. Med. Jour.*, November 4, 1922, p. 864.

MacLennan enumerates the "various ostensible causes" of scoliosis under the following heads: heredity, osseous defects, rickets, tuberculosis, fractures, tumors, osteoarthritis, paralysis, syringomyelia, Friedreich's ataxia, hemiplegia, spastic paraplegia and poliomyelitis, muscular weakness, muscular spasm, secondary to wry neck, postural, empyema, inequality of length of legs, gravity.

As to the theory of development, he considers the rotation as a necessary mechanical result of unequal growth in vertical length of the bodies and the arches representing respectively the anterior and posterior sections of the compound upright column. Inefficient growth of the anterior part, or the bodies, results in kyphosis, while inefficient growth of the posterior portion—the arches—increases lordosis, a result easily attained in the cervical and lumbar regions, but not so easily attained in the dorsal region, where lateral projection of the unequal growth takes place. He favors the Abbott method for forcible correction and also favors operation in selected cases—not after 15 years, when the deformity is apt to be fixed. The operation is as follows: "A four-inch incision

is made over the convexity of the curve. It is placed just external to the tips of the transverse processes. The dissection will vary according to the locality, but the muscles are split rather than cut. The posterior nerve branches are conserved as far as possible, as their division is liable to be followed by the development of a hyperaesthetic area just where subsequently sustained pressure is required to be made. Two, or at most three, ribs are resected from their angles to their articulations with the vertebrae. The pleura is very liable to injury, and the wound retractors should be wrapped in gauze to minimize this risk. The tissues over the vertebral bodies are raised from the lateral fossa, avoiding injury to vessels or nerves. On account of the deflection of the vertebral bodies towards the convexity they are much more accessible than would be expected.

"The body of the vertebra forming the center of the curve is excavated and the same is done to the vertebra above and below, though not to so complete an extent. The intervertebral substance is nibbled or cut away. With the finger in the cavity so made, the spine is forcibly flexed towards the convexity. The wound is closed in layers, without drainage. A plaster of Paris jacket is applied with the spine flexed laterally as much as possible." Finishing the description of the operative procedure, he says: "Having obliterated the growth of more than one vertebral epiphysis the distortion will tend to reduce as the posterior part of the spine increases in length." He does not say how many cases he has operated upon, but states that, "In the cases so operated upon I have been more than satisfied that the risk involved is compensated for by the improvement."—*C. A. Parker, M.D., Chicago.*

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OBSERVATIONS ON THE CORRECTIVE AND OPERATIVE TREATMENT OF STRUCTURAL SCOLIOSIS. Armitage Whitman. *Arch. of Surgery*, November, 1922, p. 578.

This is a summary of three years' experience with a new operative method used at the Ruptured and Crippled Hospital, New York. The author deals with the so-called "idiopathic scoliosis," with fixed, structural deformity. He applies plaster jackets after the method described by Kleinberg, with the patient suspended, using lateral pulls holding down the high shoulder, and cutting a window over the concavity. As much correction as possible is obtained in this manner. The problem then is to maintain the correction obtained and this is done by a fusion operation on the spine rather than to attempt to maintain the correction by wearing jackets or braces over a period of years. First operation was performed June, 1920. Since July, 1920, 15 patients have been operated upon. When the corrective jackets are removed the patient is put upon a convex stretcher frame supported above the bed for a few days, to accustom the patient to this position and to prepare the skin for operation. A fusion operation is then performed on the spine. As soon as the postoperative discomfort is over, traction is applied to the head by a Sayre suspension and to the pelvis by a belt and straps passing over the foot of the bed. Weights are gradually increased up to 20 pounds on the head and 30 pounds on the pelvis. Some-

times lateral traction is applied against the convexity of the ribs to aid in correcting the deformity. The time consumed in the operation is from an hour to an hour and three-quarters. There is considerable shock. There have been no deaths or infections. The patient remains on the frame for two months. A short strait-jacket is then applied, which is worn for about two months or longer, depending upon the strength of the patient. The operation is a combination of the Hibbs and Forbes operations, attempting to get as much fusion as possible.

The author states that he hopes no wave of enthusiasm for "operative treatment of scoliosis" will develop. The operation is only a final step in a tedious process of correction and offers little that is new unless it is the principle of balance on which it is performed. It should not be urged upon the patient. It is essential that the patients themselves be desirous of the treatment and willingly and actively coöperate in the treatment. There follows a report of 11 cases with photographs and roentgenograms.—*F. G. Hodgson, M.D., Atlanta, Ga.*

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## FRACTURES AND DISLOCATIONS.

THE DELBET WALKING PLASTER FOR TREATMENT OF DELAYED UNION IN FRACTURES OF BOTH BONES OF THE LEG. LeRoy C. Abbott. *Arch. of Surgery*, November, 1922, p. 485.

Delayed union is common in fractures of both bones of the leg, especially those in the lower third. This method of treatment is safer, simpler, and produces better functional results than operation and fixation, especially with metal plates. The bone ends are stimulated by use to better callus formation, the circulation of the limb is improved, the muscle strength and joint motions are improved.

The apparatus consists of moulded plaster of Paris splints applied next to the shaved and greased skin, two lateral splints from the sole to the knee, and held together by circular bands just below the knee and another at the ankle. The plaster must be very smooth and carefully moulded to the tuberosities and malleoli while it hardens. The patient walks first with crutches, then with a stick only. Splints are changed about once a month. Roentgenograms are taken every six weeks to observe the callus production. In three to five months consolidation usually occurs. Diagrams showing the method of preparing and applying the splints are shown. Four cases are reported with serial x-rays showing the development of callus and the final results. They are quite convincing.—*F. G. Hodgson, M.D., Atlanta, Ga.*

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THE PROGNOSIS OF FRACTURES. Astley P. C. Ashhurst. *Surg., Gyn. and Obstet.*, November, 1922.

In an editorial Dr. Ashhurst calls attention to the rapidity with which fractures in children unite as compared with those in adults, that the impairment of function differs according to the bone that is broken and according to the location of the fracture in that bone. He holds that, as long as function is good, poor position as shown by the x-ray may be ignored. He deplores too long absolute fixation.

He advocates prompt and accurate reduction, early active motion consistent with good apposition, and care and attention to the soft parts and skin.—*H. A. Pingree, M.D., Portland, Me.*

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TREATMENT OF FRACTURED CLAVICLES. W. L. Bell. *Annals of Surgery*, November, 1922.

In order to obtain more stable fixation than is usually obtained with Sayre's, Velpeau's, adhesives, staves, Brown's shaped sheet metal, etc., the author uses plaster of Paris. A chest cast is made first to secure a permanent holding foundation. Then the arm is enclosed in plaster to the elbow. Finally, on the following day, with the body cast as a base and a stable foundation, the arm and shoulder joint carrying the outer clavicular fragment is extended, with counter pressure against the chest cast, outward, upward, backward. When the outer fragment is properly elevated, extended and placed, a wiped joint of plaster of Paris is applied around the gap between the arm and body cast and this position scrupulously maintained until the extension ring or wiped joint has thoroughly set. Slight abduction of the arm facilitates placing the circular plaster which covers ample chest, axillary and arm padding.—*E. Z. Holt, M D., Atlantic City, N. J.*

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FRACTURE OF THE TIBIAL SPINE: AN EXPERIMENTAL STUDY. Frank E. Blaisdell, Sr. *Arch. of Surgery*, November, 1922.

After a consideration of the normal functions of the crucial and periarticular ligaments of the knee, the author gives the results of force applied in various directions to the knees of cadavers, with special reference to injuries to the tibial spine without serious damage to other structures.

Force applied on the front of the lower part of the thigh, driving the femur backward on the tibia, produced rupture of the anterior crucial (greater force rupturing both crucials), fracture of the tibial spine or avulsion of a fragment of the femoral condyle at the anterior crucial attachment. Similar results were obtained when the force was applied to the posterior aspect of the upper part of the leg, the thigh being fixed. Similar effects on the posterior crucial and its bony attachments were produced when the direction of forces against femur and tibia were reversed. These effects were produced without serious damage to other structures.

Violence applied laterally was found to result in a complicated injury-fracture of femoral condyles, tibial tuberosities, or fibular head, crucial triad involvement, with dislocation of knee in varying degrees. Inward rotation of leg on thigh, with knee more or less fixed, may result in injury to the lateral meniscus or may involve the crucial triad.

Outward rotation of the leg, with the knee more or less fixed, may lacerate the medial meniscus or involve the crucial triad.—*R. W. Billington, M.D., Nashville.*

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TREATMENT OF DISABILITIES OF HAND AND WRIST: ANATOMIC REVIEW IN RELATION TO FUNCTION. W. A. Cochrane. *Edinburgh Med. Jour.*, September, 1922.

Cochrane emphasizes the necessity of being familiar with the detailed physiology of the hand in the care of its injuries and diseases in order to reduce the resulting disabilities to a minimum. He discusses the necessity for preserving as far as possible the anatomic form and the best positions for function, directing particular attention to the action of the thumb as controlled by the opponens pollicis. Where this action is destroyed, he favors an arthrodesis of the carpometacarpal joint in the position of abduction and opposition to the fingers. In Colles fracture he recommends the Cotton-Loder position of correction, flexion of the wrist and pronation of the radius around the head of the ulna. For stiff fingers he suggests long-continued extension of fingers by means of cords fastened to the fingers with tapes and attached beyond the tips of the fingers to a hoop splint supported by the forearm. This he claims opens up joint spaces and makes the ligaments more pliable. The author has done well to present this important matter of hand injuries to the profession, as it is far too frequently the practice in general hospitals to pass such treatment over to the junior surgeon or interne as a matter of little moment or a good chance for the young surgeon to get some practice. Often at such a fearful cost to the patient!—*C. A. Parker, M.D., Chicago.*

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FORWARD DISLOCATION OF BOTH BONES OF THE FOREARM AT THE ELBOW: REVIEW OF THE RECORDED CASES AND THE LITERATURE WITH REPORT OF CASE. Isidore Cohn. *Surg., Gyn. and Obstet.*, December, 1922.

Dr. Cohn has given us an extensive and very interesting résumé of the subject, dating back to 1787. He gives a report of 16 cases, including one of his own. He also quotes six cases from the literature which were complicated by fracture of the olecranon process. The reports are much detailed and very interesting when we think that the findings in some of them were made over 125 years ago, and in almost all of them before the discovery of the x-ray. The entire article is well worth reading. There are five radiographic illustrations. Dr. Cohn's conclusions follow:

"Anterior dislocation of both bones of the forearm is rare. Only 23 cases, in-

cluding the case herewith reported, have been found in a review of the literature. In all cases which have been verified by operation or autopsy there has been an extensive laceration of the ligaments about the joint and a stripping up of the muscles in the immediate vicinity from the respective bones.

"Anterior dislocations of the elbow may be either uncomplicated, or associated with a fracture of the olecranon or coronoid process. A review of the literature suggests that some of the cases have been reduced with very little difficulty.

"The case which forms the basis of this report showed that there was an extensive stripping up of muscles and interposition of soft parts between the lower end of the humerus and the ulna. Such a condition shows the impossibility of a non-operative reduction, particularly if seen late, as in this case.

"The approach to the elbow in such instances had best be done by lateral incisions rather than the linear posterior incision or the method recently suggested by MacAusland. The position after operation had best be one of complete extension, because the olecranon in complete extension is fixed in the olecranon fossa behind the trochlea. If the elbow is put in hyperflexion there is a tendency of the olecranon to slip forward again and reproduce deformity. After a few days it is advisable to begin mobilization of the joint."—*H. A. Pingree, M.D., Portland, Me.*

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RESULTS OF TREATMENT OF FRACTURED FEMURS IN CHILDREN, WITH ESPECIAL REFERENCE TO BRYANT'S OVERHEAD TRACTION. W. H. Cole. *Arch. of Surgery*, November, 1922.

Of 35 cases, four were pathologic and 31 were simple fractures, 18 of which were treated by overhead traction. In the upper third there were three cases, all transverse. In the middle third there were 21, six being transverse, 14 oblique, and one greenstick. In the lower third there were seven, six being transverse, and one oblique.

Overhead traction has the advantages of simplicity of application and after-attention, comfort, and cleanliness, especially for the very young. It is advised in all types up to the age of about 10 years. Coaptation splints are also applied. Traction is by the usual adhesive plaster and cord passing through two pulleys on an overhead bar, one pulley directly above the hip and the other at the foot, so that the weights are out of reach of the patient.

All cases treated by this method are said to have obtained satisfactory functional results, though in several there was some overlapping or other imperfect apposition of fragments, especially in the transverse cases. Six of these cases were examined two or more years later and showed marked improvement in x-ray appearance. Cases healing with slight overlapping later show no shortening. The author speculates as to where and when this compensatory lengthening takes place and seems to think it is the result of the traction on the soft growing bones. However, there is no comparison of measurements taken at the end of treatment with those taken after two or three years.—*R. W. Billington, M.D., Nashville.*

THE COMBINED TREATMENT OF FRACTURES OF THE SHAFT OF THE FEMUR. E. L. Eliason. *Surg., Gyn. and Obstet.*, October, 1922.

Dr. Eliason treats his fractured femurs by means of Sherman bone plates and screws in conjunction with plaster of Paris and traction. The leg and thigh are both maintained at about 50 degrees flexion to produce muscle equilibrium. He goes very minutely into the details of the operative work, and leaves in a drain. Apparatus is kept on for seven weeks, and complete weight-bearing is allowed in six months. A report of 13 cases is given, which is illustrated with 23 excellent cuts. Dr. Eliason's summary and conclusion follow.

"SUMMARY.

"1. In the 11 operative cases all were drained and no infections occurred.

"2. No case had a bad result; the greatest shortening was one-fourth inch.

"3. But one plate had to be removed and that was due to two errors, *i.e.*, too large a fenestration and no traction.

"4. The follow-up reports after months, and in a few cases, years, show no changes for the worse, and no plates have had to be removed.

"5. Every one of the 13 patients had a first-class limb, with no limps and joint limitation, but slight in two cases.

"CONCLUSION.

"Judging by this small series, the best treatment for fracture of the shaft of the femur is the continued use of internal and external fixation in the full sense of the word. It gave 100 per cent. good results."—*H. A. Pingree, M.D., Portland, Me.*

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SNAPPING SHOULDER AND VOLUNTARY SHOULDER DISLOCATION. Max Kappis. *Arch. f. Orth. u. Unfall-Chir.*, 1922, XX, 4 H., p. 535.

Author reviews 13 cases as reported in the German literature as voluntary dislocations that he concludes are shoulder snappers. The displacement takes place with a snapping noise and depends mostly on the fact that the joint is brought *in toto* by voluntary muscular activity into an abnormal position, whereby it is shoved under a stretched muscle, usually backward. With disease or paralysis of the muscles, such an occurrence can become habitually involuntary. The cause of the abnormality is frequently congenital, but appears later in life. The muscles that cause the snapping movement of the shoulder joint vary in different cases, but there is usually some weakness of part of the deltoid muscle. The diagnosis is simple. The x-ray, at any rate, will show normal joint relations in every position. The prognosis is good. There are no complaints of any importance. The abnormality apparently disappears of itself in the course of time with decreased use of the muscle and lessened bodily cleverness. All therapy, therefore, is superfluous, with voluntary shoulder snapping. An apparatus can be worn if it ever becomes necessary. Operative interference consists of better fixation of the scapula to the clavicle either by reinforcement of the ligaments between them or by ankylosis of the acromioclavicular joint. Of course, this results in severe disturbances in function.

Habitual luxations at times can be voluntarily produced, but only seldom can they be voluntarily reduced and cause a snapping. True voluntary luxations are very rare, and like habitual voluntary luxations are only possible with severe joint injury. In addition there is a form of shoulder snapping produced by the checking of the normal joint motions by some intra or extra-articular causes which are overcome by a sudden snapping.—*Armin Klein, M.D., Boston.*

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EXPERIMENTAL STUDY OF THE HEALING OF FRACTURES. Leonard W. Ely. *Arch. of Surgery*, November, 1922, p. 527.

This study was undertaken to clear up several obscure points in the process of healing of fractures, but chiefly to ascertain the exact rôle assumed by the periosteum. Three sets of experiments were performed on the humeri of cats. Series 1. The bones were fractured by direct violence, using the hands. Series 2. An incision was made, the periosteum was divided circularly and the bones cut. Series 3. Similar to the second except the periosteum was slit longitudinally and the bone cut across. Author reports in detail the microscopic autopsy findings in 14 cats in Series 1, six in Series 2, and six in Series 3. The cats were killed at various periods from four days to 11 weeks. In his comments he states that in none of the slides was there any evidence of any active part taken by the periosteum in the actual formation of new bone, and yet the periosteum must play an important rôle of some kind, for where it was divided there non-union regularly resulted. He states that periosteum is composed of fibrous tissue, and nothing like a second layer (cambrium) can be made out. He then discusses various theories about bone formation.

CONCLUSIONS.

1. The periosteum has a function to perform in the healing of fractures.
2. The ossification of the soft callus takes place from the external aspect of the cortex: These conclusions are elaborated. This is an excellent piece of experimental work and should be read by all who are interested in this much discussed and still unsettled question.—*F. G. Hodgson, M.D., Atlanta, Ga.*

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DISLOCATION OF THE SEMILUNAR CARPAL BONE. Harry B. Knapp. *Jour. Amer. Med. Assn.*, December 9, 1922, p. 1992.

The anatomy, frequency, symptoms, and diagnosis of this condition are taken up and the treatment is outlined. Prolonged hot application followed by bloodless reduction generally accomplishes cure. Open operation is successful by the use of the Davis skid; excision is practically obsolete. One case treated by open operation is reported.—*Edward S. Hatch, M.D., New Orleans.*

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SUBASTRAGALOID DISLOCATION OF THE FOOT. Beveridge H. Moore. *Surg., Gyn. and Obstet.*, December, 1922.

Dr. Moore gives the history and occurrence as they appear in the medical

literature of the past. From his statements we may conclude that it is a relatively infrequent result of injury, and by experiment it has been shown that fracture is more likely to occur than ligamentous rupture.

Dr. Moore reports three cases which occurred in his own practice, and two of these were of many years' standing. The injuries and symptoms are carefully described, and the treatment covered briefly. The functional result in each case was most satisfactory. The paper is illustrated by means of four excellent photographs. Dr. Moore's own summary follows:

SUMMARY.

Subastragaloid dislocation of the foot is a rare injury, alternative with abduction and adduction fractures in the region of the ankle.

The physical signs of subastragaloid dislocation outward are eversion and abduction of the foot, with prominence of the head of the astragalus on the inner side of the foot. In old cases there is lowering of the malleoli and thickening of the foot below the malleoli.

Treatment in recent cases is reduction, either open or closed, as may be indicated. Total astragalectomy gives good results in old cases.—*H. A. Pingree, M.D., Portland, Me.*

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FRACTURED CLAVICLES. T. K. Richards. *Jour. Amer. Med. Assn.*, November 25, 1922, p. 1839.

The method here advocated is a slightly modified clavicular cross, or T splint. The width of the cross bar of the T is of a width corresponding to the width of the shoulder at the axilla and of a length about two inches shorter than the width across the shoulders. There is no padding over the shoulders where the straps or bandages hold the shoulders to the cross bar; instead, webbing straps from 1 to 2 inches wide (according to the patient, adult or child) are used, over which have been slipped pieces of heavy rubber tubing from one-half to three-fourths inch in diameter and about 8 inches in length. The whole apparatus is in one piece and can be applied by one pair of hands.

It enables the patient to be up and about with nearly full use of his arm.

It does away with any danger of injury to nerves and blood vessels from tight bandaging.

It is comfortable, easy to keep clean, and prevents the chafing of the skin.

When the apparatus is removed, the function of the shoulder, as well as the other joints of the arm, is present, and the minimum time is lost before the patient can resume his daily work.—*Edward S. Hatch, M.D., New Orleans.*

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FRACTURES OF THE TIBIAL SPINE COMBINED WITH FRACTURES OF THE TUBEROSITIES OF THE TIBIA. James Warren Sever. *Surg., Gyn. and Obstet.*, November, 1922.

Dr. Sever gives a brief consideration of fracture of the tibial spines, and the general symptoms connected with such injuries.

He then reports eight cases, from which it would seem that fixation in exten-

sion for many weeks, followed by baking, motion, and massage, will in the course of a year or more result in a very useful joint. Having in mind the severity of the injury and the simplicity of treatment, one is impressed by the very satisfactory function which is obtained.

The paper is illustrated by means of 11 half-tone pictures of radiographs.—*H. A. Pingree, M.D., Portland, Me.*

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COMPRESSION FRACTURES OF LOWER END OF RADIUS. J. H. Stevens. *Annals of Surgery*, November, 1922.

Colles fracture of the wrist is called compression fracture of the lower end of the radius.

Impaction does not exist, but the real pathology consists of a crumpling up of the posterior cortical surface of radial bone, a crush which permits a reversal of the plane of the inferior radial articular surface.

In the type showing clearly the effect of a tremendous compression, the distal fragment is displaced backward, and the so-called impaction is clearly in evidence. There is always a crushing of cortical bone on the posterior or posterior and external side of radius. If an x-ray of these cases is taken after reduction, although the fragments are perfectly movable under the fingers, nevertheless, the x-ray demonstrates that the reversal of the antero-posterior angle or plane of the inferior articular surface of the radius, which is normally between 14 and 22 degrees in front of a line erected at the level of the anterior edge of the radius, still remains in all the cases of the serious type. In other words, the antero-posterior plane of the radial articulation has been reversed, and in all of the cases remains reversed, even after reduction.

What do we mean by reversal of the antero-posterior angle? On an x-ray plate of a lateral view of a normal wrist, draw a line straight down the middle of the shaft of the radius. At the level of the anterior inferior edge of the radial articular surface, let us erect a perpendicular to this first line and carry it through this line an equal distance posteriorly. We shall find that such a line cuts the posterior surface of the radius some distance above the articulation. In other words, the normal plane of the articular surface is anterior to this line. Now if we draw another straight line, beginning at the anterior inferior edge of the radius at the same point anteriorly where we began to erect our perpendicular, and draw it just touching the edge of the posterior inferior articular surface of the radius, we shall find that this last line, representing the slant or plane of the inferior radial articular surface will always form an angle with our perpendicular of from fourteen to twenty-two degrees of the arc of a circle, and that this angle is always in front of the perpendicular. This, then, is the normal antero-posterior angle of the lower radial articulation, and it is usually about eighteen degrees.

The angle measured in the x-ray plate of a crush fracture shows that it is reversed; in other words, the line representing the plane of the articular surface which in the normal was fourteen to twenty-two degrees in front of the perpendicular line is now behind it, and often an equal distance behind, and even after so-called reduction this reversal of angle persists. There has been

an actual destruction of bone on the posterior surface of the radius and the inferior fragment has consequently tipped backward and has been displaced in this direction. It is held rigidly by the bow-string tension of all the extensors, as we pointed out in the article before mentioned. The classical reduction releases the tension of these bow-strings, and with comparatively little force the distal fragment can be moved forward approximately into its normal position. The fragment is freely movable. The silver fork deformity has disappeared, and apparently there has been a perfect reduction. An x-ray is taken and a good reduction is reported, principally because the shaft of the radius seems to be in fairly good alignment. Little attention in our experience is paid to the fact that there still persists a reversal of the normal antero-posterior angle of the inferior surface of the radius. Now if this were due to impaction, the impaction obviously having been broken up, a freely movable fragment resulting, there would now be no evidence of this so-called impaction.

The unlocking of the inferior fragment of the broken radius is easily accomplished by hyperextension, thus releasing the bow-string tension of the thumb extensors, the extensor carpi radialis longior and brevior, the extensor indicis and the tendons of the common extensors of the fingers. Local pressure over the fragment with the thumb, traction, and then strong flexion of the wrist with the fingers extended, flexing the wrist to a right angle. This is the important movement in reduction, and flexion afterwards will be exactly proportionate to that degree of flexion which is attained forcibly at the time of reduction. Circumduction movement is of no importance, but a strong adduction should always be used to reduce lateral displacement and in order to restore the lateral angle which is often disturbed. In the majority of cases this will suffice for the reduction, but, nevertheless, they will still show the reversal of the antero-posterior angle, and sometimes to a tremendous extent. While we can return these wrists to practically the normal range of motion, almost as quickly as the apparently much less seriously injured, nevertheless, with this persistence of reversal there must always be at least a slight deformity on the front of the wrist, and a slight limitation of flexion.

We have reduced the fracture, the inferior fragment is freely movable, and we have pushed it forward into place. Remember that nearly always the fragment is permitted to remain too far posteriorly. The operator is afraid of pushing it to the front too far, and therefore often he fails to fully reduce. Push it forward firmly. Flex the hand to the limit at right angle to the wrist. Adduct to the limit to restore the lateral plane of the articulation; mould locally with the fingers, and put on the posterior splint—angled 40 degrees flexion and 30 degrees adduction. Take an x-ray, immediately, for verification. A wrench may be used, but never until after the bow-string tension has been released. It is the last thing to use in order to obliterate the last vestige of reversal of angle. It is never to be used as an instrument for reducing the fragment.

The most essential feature of the treatment of a fracture of this type is motion quickly, as we have pointed out many times. Motion is begun in these cases not later than the fourth day, but the posterior splint is left in place during the motion, the hand to the wrist being freed and moved gently in

flexion and adduction. Extension in these cases is not carried beyond the posterior splint, until after seven or eight days, and even then the wrist is not extended beyond the horizontal plane for some days longer. By this time there has been a filling in of the posterior gap in the bone by soft callus, and it is sufficient to retain the position. Abduction is left to the last. By even a few degrees of motion one can accomplish almost as much as by the fuller arc which is employed in all cases not showing this angle of reversal.

In an ordinary fracture of the lower end of the radius with any retention or restriction apparatus after the tenth or twelfth day, except a leather wrist strap, is a case maltreated. This is true of nearly all of these cases, but in this type where reversal of angle has been great, and we have succeeded in restoring the angle to a practical normality, we have added a few days, and it is usually about twelve to fourteen days before we discard entirely the posterior splint. By the twelfth or fourteenth day, these cases have only a leather wrist strap, with an ulnar cut-out for protection, and their final recovery is no less rapid than the others. From this time on, they use the hand for all ordinary purposes which are not accompanied by strain, but with care and common sense.

Reduce the displacement, begin motion early, and get away from all retentive apparatus as quickly as possible in these joint injuries, and we shall no longer have wrists which show a permanent disability following even the simplest of these compression fractures of the lower end of the radius.—*E. Z. Holt, M.D., Atlantic City, N. J.*

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THE TRANSOLECRANON APPROACH IN TRAUMATIC LESIONS OF THE ELBOW. H. Vulliet. *Presse Médicale*, December 9, 1922, p. 1065.

The paper concerns itself with fractures of the elbow in childhood, irreducible without operative interference. The writer's indications for this operation are (1) Fracture of the external condyle with the fragment displaced backward and turned roundabout, benefits by immediate operation. In most cases a small external incision suffices, but where this is insufficient, the joint should be opened by cutting through the olecranon. Without good replacement this fracture is apt to leave much deformity. (2) In transcondylar fractures near the epiphysis, it is generally possible to maintain good reduction without operation. In exceptional cases, however, with severe displacement laterally and posteriorly, an operation is necessary, and here the transolecranon approach is ideal. The operation itself is briefly described. A removable nail is used to fix the fragment. The olecranon is replaced by fine metallic suture. No drainage is used. Mobilization begins gently about the tenth day, and removal of the nail about the fourteenth day. Two illustrative cases are cited.—*J. A. Nutter, M.D., Montreal.*

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DIAGNOSIS AND TREATMENT OF INCOMPLETE EPIPHYSEAL FRACTURES AT HIP. R. Whitman. *Annals of Surgery*, November, 1922.

The condition is usually confused in orthopaedic literature with a group of

static deformities under the title coxa vara.

Fractures of the neck of the femur during the developmental period may be divided into two distinct classes.

(1) Fracture of the neck proper and (2) fracture at the epiphyseal junction.

In childhood the fracture is practically always of the neck.

Epiphyseal fracture or slipping occurs, with rare exceptions, only in adolescents. It is generally incomplete and presents the characteristics of a progressive deformity rather than those of fracture. The exciting cause of displacement is apparently a superficial fracture at the superior portion of the junction. Gradual downward and backward displacement of the head upon the neck follows. Symptoms—Weight is borne on entire foot. Persistent outward rotation of the limb which is increased by flexing the thigh. Actual shortening is present, but rarely exceeds one-half inch. Passive movements are restricted in flexion, abduction, and inward rotation, while extension—the movement first limited in disease—is actually increased in range. X-ray is distinctive—the elevation of the head is lessened and the outline of the head and neck may form an unbroken line on the upper border. The epiphysis is shallow—an indication of backward displacement. An actual separation may be present at the upper border.

The condition should be treated as a fracture. Under anesthesia, the pelvis having been fixed by abduction of the sound limb, the limb on the injured side is abducted to the degree permitted by the deformity. At this point the upper rim of the acetabulum, coming into contact with the neck, serves as a fulcrum and the head being fixed by the tense capsule, further abduction tends to force the extremity of the neck downward into proper relation with the head. This may be accomplished if the progression of deformity has been rapid, or in cases of secondary fracture it may be necessary to make two or three attempts before the restriction of range of motion is overcome. In cases in which the displacement is too great or the consolidation too advanced, open reduction will be necessary.

The joint is opened by an anterolateral incision exposing the neck, which in cases of advanced deformity conceals the head. From its extremity a thin section of bone is removed to permit the incision of the chisel between the two fragments, then, by rotation of the limb and leverage on the instrument, the head is replaced in normal position. The epiphyseal cartilage is always a part of the head fragment, so the removal of bone is of little consequence.

Limb is fixed by a long spica plaster in complete abduction and inward rotation for three months. Locomotion may be permitted in suitable cases.—*E. Z. Holt, M.D., Atlantic City, N. J.*

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IMMEDIATE OPERATION AS METHOD OF CHOICE IN TREATMENT OF FRACTURE OF NECK OF FEMUR. A. O. Wilensky. *Annals of Surgery*, November, 1922.

Fractures of the neck of the femur are divided into those occurring at the base of the neck in proximity to or crossing the intertrochanteric line and those which occur partially or completely within the capsule. This paper deals with the latter group. The traction method of treatment is inefficient. Plaster of

Paris is more satisfactory. Conservative treatment is recommended in the old and the very young.

In considering cases of the second group—solid bony union occurs in only 10 to 15 per cent. of these cases. Difficulties and bad features encountered in treating fractures by abduction and fixation are many. Two case histories are used as illustrations. The pegging of the fracture with a living graft immediately after the injury is received is the method of choice in fracture of the neck of the femur in robust individuals. The technique of the operation is described in detail. The graft is so cut as to fit loosely in the drill hole extending into the neck and head of the femur. The cast is left undisturbed for two months. Patient is massaged and passive motion practised in bed for a month. Ambulatory splint is prepared and patient allowed to walk with the aid of the splint at end of the third month. Brace is discarded at end of six months.

Seven advantages of immediate operation are cited: (1) an accurate apposition of the fragments, and (2) their permanent retention in that position until the fragments are united; (3) the use of a living graft to encourage and aid the formation of sufficient callus; (4) a marked diminution in the time necessary for complete healing of the fracture; (5) the consequent economic saving; (6) the better anatomical result, including no loss of the neck angle, no shortening of the neck itself, no abnormal changes in the muscles, ligaments and soft parts generally; (7) the consequent better results obtained functionally.—*E. Z. Holt, M.D., Atlantic City, N. J.*

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## NEOPLASMS.

VASCULAR TUMORS OF THE KNEE CAPSULE. Haas. *Deutsche Ztschr. f. Chir.*, August, 1922.

Author reviews the German literature, reporting nine cases of vascular tumors of the knee joint. He himself reports two cases he has observed. The first case, a man thirty years old, at operation, showed angiomatous masses of the knee joint synovia. These angiomatous masses were excised, but two years later, because of intolerable pain, effusions, and the handicap for labor, the knee joint was opened again. The angiomatous masses had multiplied greatly and had gnawed away the cartilage of the patella and the inner condyle of the femur and had penetrated into the metaphysis of the tibia. The knee joint was resected and the tibial infiltration was chiselled out. The second case was of a woman, 22 years old, with little red tumors the size of beans about the knee joint, and with complaint of great pain on climbing stairs and on kneeling, and with a limp in her gait because of the pain. At operation a tumor the size of a pigeon's egg was removed from the capsula fibrosa. Microscopic examination revealed an angioma surrounded by fat and connective tissue. In cases with intact bony frame, the author advises complete arthrectomy with extirpation of the primary angiomatous cavities, which are mostly in the capsula fibrosa. After-care consists of intensive baking, exercise, and hyperemia. The etiology of the tumor is the new formation and abundant vascular growth of the tumorlike proliferation of the blood vessels. Trauma plays an unim-

portant rôle. Bloody puncture on tapping the joint clinches the diagnosis as to tuberculosis and lues.—*Armin Klein, M.D., Boston.*

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PERIOSTEAL SARCOMA IN ASSOCIATION WITH OSTEOMYELITIS. R. L. Rhodes. *Surg., Gyn. and Obstet.*, October, 1922.

Dr. Rhodes reports three cases in a very complete and concise manner. His summary given below cannot be bettered.

"1. The author reports three cases of large round-cell sarcoma, periosteal origin, associated with infection and necrosis of bone.

"2. All females, two white, one negro.

"3. Ages, 14, 12, and 20 years, respectively.

"4. Left tibia in each case.

"5. No history of trauma or serious illness.

"6. Local pain in two, none in the other.

"7. Staphylococcus aureus infection in each.

"8. Rapid pulse and rather high fever in two, none in the other.

"9. Treatment, mid-thigh amputations.

"10. Results, one dead, and two living free from signs of recurrence, local or elsewhere, to date.

"Case 1 developed in the hospital under our observation, and we feel reasonably sure, therefore, that the osteomyelitis preceded the sarcoma.

"Case 2. We questioned which preceded, although we did not suspect the infection and necrosis or abscess prior to operation, but found it upon dissection of the specimen. Might the history, however, of attacks of pain—"growing pains" for several months preceding the development of the tumor—suggest infection or abscess as the original?

"Case 3 gave an indefinite history, and showed a well advanced growth when we first saw her. The specimen was interesting in that there was a rather sharp line of demarcation at the site of the pathological fracture of the tibia—extensive osteomyelitis of the shaft above, whereas below there was widespread invasion by the sarcoma of bone and soft parts, extending downward even to the internal malleolus."—*H. A. Pingree, M.D., Portland, Me.*

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## DISEASES AND REGENERATION OF BONE.

BONE ATROPHY: A CLINICAL STUDY OF THE CHANGES IN BONE WHICH RESULT FROM NONUSE. Nathaniel Allison and Barney Brooks. *Arch. of Surgery*, November, 1922, p. 499.

The article is subdivided as follows: *I.* Introduction (1) Summary of previous study; (2) Object of present study. *II.* Material studied: (1) Adults; (2) Children. *III.* Relation between changes in bone as a result of lack of use and the cause of the nonuse. *IV.* Character of changes in adults. *V.* Character of changes during period of growth. *VI.* Effect of nonuse on growth of bone. *VII.* Effect of nonuse on regeneration of bone. *VIII.* Recovery from bony atrophy. *IX.* Summary.

Clinical cases of nonuse due to the following causes are reported: (1) poliomyelitis; (2) spastic paralysis; (3) peripheral nerve injuries; (4) Friedreich's ataxia; (5) pseudo muscular atrophy; (6) syringomyelia; (7) chronic infectious arthritis; (8) tuberculosis of bone; (9) acute pyogenic osteomyelitis; (10) ischaemic contracture; (11) fracture; (12) congenital deformities, and (13) astasia abasia.

Sixteen cases are reported with excellent radiograms and careful measurements showing the changes which take place. In adults the process of bone atrophy alone operates. During the period of growth, bone atrophy is associated with inhibition, but not the arrest of growth by nonuse. Bone atrophy does not affect the process of bone regeneration. Even after prolonged periods of nonuse and marked bone atrophy, upon resumption of active use the bones recover from the atrophy and develop considerably, although in unilateral cases they do not return to absolutely normal or catch up with the actively used limb. Even after prolonged confinement in bed the bones show marked atrophy. This is a most interesting article, carefully prepared, and logical in its conclusion. It is a continuation and a corroboration of the excellent experimental work previously presented by the same authors.—*F. G. Hodgson, M.D., Atlanta.*

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BONE REPAIR FOLLOWING INJURY AND INFECTION. F. W. Bancroft. *Arch. of Surgery*, November, 1922.

After discussing the various theories of osteogenesis, the author states that an acceptable theory should be broad enough to explain the irregular types of bone formation as well as the repair which follows fractures and infections. He thinks the subject has been made too complex: we have been lost in the byways of periosteum, endosteum, and bone reticulum. It is much simpler to believe that bone occurs as a chemical deposition in connective tissue, a theory explaining bone formation as it appears in all parts of the body.

Believing that bone grafts serve only as a framework for new bone, and stimulate osteogenesis, we should, therefore, apply grafts that can easily have a blood supply established.

In fractures, an effort should be made to increase the blood supply: therefore, early motion is advised. The problem is that of producing the right chemical state in the tissues.

In osteomyelitis, especially in children, conservative surgery is advised. Early drainage, with as little trauma as possible, and Carrel-Dakin treatment, avoiding hasty, extensive removal of bone, will often save bone which may appear dead.—*R. W. Billington, M.D., Nashville.*

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OSTEOSCLEROSIS FRAGILIS GENERALISATA. George G. Davis. *Arch. of Surgery*. November, 1922.

This is a detailed report of a case, with review of literature and similar reported cases, of Albers-Schönberg disease. The patient was a boy, aged eleven years, who had had several fractures of long bones, each due to mild trauma.

He was essentially normal except for a recent fracture of the right tibia, and the characteristic x-ray findings throughout the whole skeleton, consisting of a generalized disturbance of the bony structure, characterized by a marked, irregularly increased density of certain portions, with thinning and rarefaction in other areas. In the long bones, the tendency was toward a marked narrowing of the medullary canals in the middle third, due to thickening of the cortex, with the ends of the shaft presenting an expanded appearance, with thinning of the cortex and a coarsely mottled effect due to increased density in the narrow cavity. The epiphyses and small bones, as vertebrae, carpals and tarsals, presented generally increased marble-like density, with absence of bone structure. Epiphyseal lines were all present, but had slightly irregular margins. The same increased density was found in the mastoids, and at the base of the middle and anterior fossae of the skull, but the vault appeared normal. The fossa for the pituitary gland was 8 mm. in diameter.

The condition is considered a separate entity from fragilitas ossium.—*R. W. Billington, M.D., Nashville.*

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CHANGES IN THE MORPHOLOGY AND FUNCTION OF THE BONE MARROW AFTER SPLENECTOMY. Ernest M. Johnstone. *Arch. of Surgery*, July, 1922.

The object of this research was to determine the behavior of the bone marrow after splenectomy, by observation of repeated specimens taken at regular intervals over a sufficient length of time, and adequately controlled.

Previous observers report negative findings for the first six months, but definite changes after six months. The most severe anemia, however, and the largest number of recoveries therefrom occur during the first six months.

Control was obtained by checking against specimens taken before splenectomy, and against specimens taken from non-splenectomized animals subjected to the same conditions as the splenectomized animals.

Maximal changes were noted during the fourth and fifth months, a period during which the previous investigators had made no observations. Rib marrow was selected for observation, since it shows changes earlier than femur marrow. Ten factors were considered, *viz.:*

In the marrow itself: erethrogenesis, leukogenesis, vascularity, and density of marrow cells.

In the blood: haemoglobin content, red cell count, white cell count, and differential study.

In regard to the animal in general: weight and general condition.

The observations were continued during a period of fifty-four weeks.

Comparison of the marrow of one animal with that of another is not safe, since marrow differs greatly in activity in different animals. There was also found a very marked difference in the activity of the marrow in several specimens taken at different times from the same control animals. Haemopoiesis seems to be somewhat periodic, and to have seasonal and other variations.

Marrow increases its capacity by replacement of fat cells with marrow cells, and by enlargement of the marrow cavity by thinning of the bone cortex and septi. The character of the marrow cells changes as activity increases, myeloblasts and myelocytes being replaced by megaloblasts and normoblasts.

After splenectomy, there is a latent period of about four weeks, then increased erethrogenesis, reaching its maximum after eight to twelve weeks, and continuing at this height about twelve weeks; thereafter decreasing gradually, though its activity remains above normal for a year or more. No reduction in the anemia is evident until the increased erethrogenesis has been in evidence four weeks or more. The marrow generates only a few lymphocytes.

The author's conclusions are that removal of the spleen from a healthy animal is followed by hyperplasia and hyperactivity of the marrow, beginning soon after splenectomy, and continuing for more than a year. This is probably the result of the anemia which follows the removal of the spleen. This increased activity is exactly paralleled by increase in cell and haemoglobin content in the blood stream.—*C. L. Lowman, M.D., Los Angeles.*

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Osteomalacia. E. P. C. White. *Arch. of Int. Med.*, November, 1922.

Osteomalacia is a generalized softening of adult bones. The following types are recognized: 1. Mild form. Pregnant, puerperal, and lactating women. 2. Severe type occurs in old people. Bone softening as a rule is confined to spine and pelvis. 3. A severe form occurs in pregnant and puerperal women. Microscopically and chemically there is absorption of calcareous salts.

The various theories are advanced: 1. Caused by hyperfunction of internal secretion of ovaries. 2. Decrease of alkalinity of the blood, which permits bone salts to go into solution. 3. Food poor in calcium. The destruction of the calcium and phosphorus metabolism may be due primarily to (1) the removal of alkaline salts from the diet (famine osteomalacia); (2) drain from the alkaline storage of the body associated with a deficient diet, as in cases of osteomalacia of pregnancy and lactation; (3) in the combined action of a diet faulty in more than the salt content, which by production of acid in its oxidation and by favoring the development of acid growing bacteria causes a drain of the body alkali for the neutralization of this acid.

In the severe cases of osteomalacia the power to absorb calcium and phosphorus is practically lost, while in the cases developing during famine and in pregnancy and lactation, this power is retained. All factors enumerated do tax the metabolic resources of the body and depress the function of the endocrine glands. The starting point of treatment must be a diet adequate in vitamins and containing a proper inorganic balance.—*Voigt Mooney, M.D., Pittsburgh, Pa.*

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## OPERATIVE PROCEDURES.

Cases of Arthroplasty of Elbow: Interposed Flap Operation. W. C. Campbell. *Annals of Surgery*, November, 1922.

Arthroplasty of the elbow should be performed only in selected cases. The following pathological conditions decrease the chances of success or actually contraindicate surgical measures.

1. Tuberculosis—in no case should a joint be entered for the purpose of mobilization when tuberculosis has been the causative agent in the production of ankylosis.

2. Destructive osteitis in early life which has obliterated the epiphyses—a materially shortened extremity is encountered.

3. Extensive scar tissue binding the skin to the bone.

4. Extreme muscular atrophy with reorganization of bone structure, as is seen when a bony ankylosis has existed for a long time, making one canal from the shoulder to the wrist.

5. Old, dense, eburnated bone when found for a considerable distance on both sides of the joint.

The two conditions in which open surgical procedures should be employed in ankylosed joints are:

1. Traumatism, causing a crushing of joint surface, tearing of periosteum, or multiple fractures, followed by bony ankylosis.

2. Acute infectious arthritis due to staphylococcus, streptococcus, gonococcus, pneumococcus, etc.

Five well-known methods of operation are outlined:

1. Wide excision of articular surfaces, which should not be considered.

2. Pedunculated fascial flaps between the articular surfaces after carving out a new joint. This method has been discarded by most operators.

3. Interposition of animal membranes.

4. Transplantation of free fascia lata.

5. Mechanical reconstruction of the articular surfaces without the interposition of any substance.

The author is now using the following method:

An incision is made six to eight inches long on the posterior aspect of the arm and forearm just external to the midline, beginning above, about the middle of the humerus, and ending below, about two or three inches below the elbow joint. Skin, superficial and deep fascia are incised and the deep fascia dissected laterally about one inch. The broad aponeurosis of the triceps is dissected from above downward, making a long tongue attached to the tip of the olecranon below. A further incision in the midline passes through the muscular fibers of the triceps and periosteum to the humerus over the lower half. A periosteal elevator is used to strip the periosteum from the lower end of the humerus. Scar tissue, callus, and loose bony particles are removed. If dislocation exists, reduction is accomplished. About one-half to one inch is removed from the lower end of the humerus, which is remodeled into a surface convex from before backward, no attempt being made to reproduce trochlea or capitellum. About one-half inch bone is removed from tip of olecranon. All scar tissue is dissected from the sigmoid cavity. The surface is not disturbed but the surface of the head of the radius must be made the same level as the coronoid process. A rasp and file render all surfaces smooth. The periosteum and triceps muscle are dissected into a double flap which is stitched to the anterior capsule, thus separating the raw bony surfaces by a living mass of tissue with abundant blood supply and no risk of pressure necrosis. The capsule of the joint is stitched to the posterior aspect of the triceps muscle and deep fascia, thus closing off the new joint. The wound is then closed in layers.

The after-treatment is important. Active motion is most essential.

The method is illustrated by details of two cases.—*E. Z. Holt, M.D., Atlantic City, N. J.*

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PATHOGENESIS AND TREATMENT OF DEFORMITIES OF THE GREAT TOE. Second Question Discussed at the Fourth Congress of the French Orthopaedic Society. Albert Mouchet. *Presse Médicale*, October 14, 1922.

1. Hallux valgus is seen especially in the adult, and a little more often in women. It is generally bilateral and often seen with flat feet. It is congenital more often than it is supposed to be. Young explained this by the intermetatarsal bone, a supernumerary bone between the internal cuneiform and the first and second metatarsals. This is probably exceptional. The mechanical action of improper footwear is undeniable, but Kirmisson holds that the first place in the list of causes should be given to arthritis of various kinds. Well-fitting shoes should cure most cases of hallux valgus. They should be long enough and broad enough. In young subjects forcible correction followed by immobilization will cure. If a proper shoe fails to relieve, one must operate. In elderly persons palliative measures are best. Tendon operations will not cure and amputation of the great toe is not recommended, except possibly in elderly persons.

Schede extirpates the painful bursa and resects the exostosis, a plan which is of service only in mild cases.

Reverdin's operation consists in carrying out Schede's procedure and then removing a wedge of bone from the metatarsal head, the base to the inner side, allowing correction. This operation is popular. The resection of the metatarsal head (Hueter) is an excellent and popular operation.

Edmond Rose and Lovett resect the metatarsophalangeal articulation and extirpate the sesamoids.

Mauclaire (Paris) does oblique resections of the head of the metatarsal and of the base of the phalanx. Postoperative care is of the highest importance.

1. Hallux varus is either acquired, which is rare, or congenital, which is seen more frequently as a supernumerary toe. The treatment is surgical, may be amputation.

Mr. André Trèves (Paris) described an operation where the cartilage on the metatarsal head was kept and placed against the raw bone left by resection. He transplanted the long extensor to the inner side, after lengthening it if necessary.

Dr. Tixier of Lyons, Dr. Paul Hallopeau of Paris, Dr. Lance of Paris, and Dr. Bocher of Bordeaux all favored simple resection of the head of the first metatarsal.—*J. A. Nutter, M.D., Montreal.*

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A NEW APPROACH TO THE SEMILUNAR CARTILAGES. Percy Willard Roberts. *Jour. Amer. Med. Assn.*, November 4, 1922, p. 1608..

The author feels that the period of convalescence following operation for excision of the semilunar cartilages of the knee can be shortened by early mobilization of the joint. He reports eight patients operated on by the following technic, and supplies two excellent diagrams.

The purpose of the operative approach is to place the wound so that no

strain will come on it when the knee is bent. A blunt V-shaped incision is used, one arm which starts about three-eighths inch above the upper border of the tibial condyle and follows down the border of the patellar ligament for one and one-half inches; then carried transversely, then up inside of the lateral ligament to the level of the upper end of the opposite arm; cut carried down through all the tissues, including periosteum. Flap then raised and retracted upward; coronary ligament incised transversely, retraction continued until the lower surface of the meniscus appears on the under surface of the flap. Cartilage removed, wound closed by uninterrupted chromic gut sutures; synovial membrane not sewed. Skin closed with silk. Patient urged to move joint as soon as he comes out of ether and repeat every two hours; passive motion prohibited.—*Edward S. Hatch, M.D., New Orleans.*

## MISCELLANEOUS.

PATHOLOGIC CHANGES IN MUSCLE AS A RESULT OF DISTURBANCES OF CIRCULATION. AN EXPERIMENTAL STUDY OF VOLKMANN'S ISCHEMIC PARALYSIS. Barney Brooks. *Arch. of Surgery*, July, 1922.

After a review of the more important researches on the subject, the author describes his own experiments, which consisted in interference with the circulation or the innervation or both circulation and innervation of the muscles of the extremities of dogs in the following ways:

1. By constriction with tourniquets, splints, and plaster bandages, kept on from five to 24 hours.

The conclusions from these experiments were that such constriction affected both innervation and circulation, that the degree of interference could not be controlled, and that the results were not uniform.

2. By permanent obstruction of the primary arteries of an extremity by ligation.

The results were:

(a) A coldness, stiffness, and easy fatigability of the muscles, entirely recovered from with establishment of collateral circulation.

(b) The above, coupled with more extensive changes, *viz.*, a sharply localized necrosis of skin, and sometimes of tendons, and degeneration of portions of muscles—the rest of the musculature regaining later its entire function.

(c) Total paralysis and necrosis of some muscles and total non-paralysis and viability of others, with one exception, which showed a single muscle in part paralyzed and necrotic and in part non-paralyzed and viable.

These degrees of change corresponded with the extent to which collateral vessels were ligated. The condition produced corresponds to the well-known clinical condition to which the term ischemia is applied, and which seems to be a fatigue phenomenon.

Two points are emphasized concerning these experiments:

(a) That where the anatomic integrity of a muscle was unimpaired its physiologic function always remained intact.

(b) Necrosis of skin was always produced earlier and to greater extent than necrosis of muscle, and in several instances without accompanying necrosis of muscle.

3. By temporary obstruction of the primary arteries of an extremity by application of clamps, later to be removed. The clamps were left on for different lengths of time, from six to 24 hours.

In these experiments the most extensive changes were not in the skin, but in the muscles. In all there was coldness of the extremity and paralysis of muscles while the clamps were on. On removal after six hours there was complete return of function. In some of those animals where clamps were left on for 17 hours or longer, there followed extensive necrosis of muscles even though good pulsation returned in all the larger arteries of the extremity. This necrosis was preceded by inflammatory reaction.

In one experiment where clamps were left on for 17 hours the return of pulsation in the arteries was very feeble, and in this case there was no inflammatory reaction or swelling, and on exposure of the muscles before death of the animal, they showed mottling with pink areas which responded to electrical stimulation, and yellow areas which failed to respond.

4. Experiments on isolated muscles: The rectus femoris muscle having been freed completely except for its tendinous origin and insertion, and its connection with artery, vein, and nerve, a tight ligature was tied around each end of the muscle to isolate it completely from all other vascular connection.

(a) The nerve was divided, leaving artery and vein intact. The result was primary atrophy rather than degeneration.

(b) Ten c.c. of blood aspirated from the femoral vein was injected into the muscle, distending it with blood. Examination after one month showed no abnormality, either physiologic or anatomic.

(c) Ligature of the artery, leaving the vein intact. Examination at some seven to 60 days, postoperative, showed normal physiologic properties, adhesion of the muscle to the surrounding tissues, and slight degenerative changes in some instances.

(d) Section of artery and nerve. Examination after 60 days showed the typical atrophy of nerve paralysis.

(e) Ligation of the artery with diminution of the blood supply to the entire extremity by other ligations: The result was either no change in the muscle, or complete absence of the muscle in seven to 12 days if the circulation of the extremity was extensively blocked. The muscles either retained wholly their physiologic and anatomic characters or became wholly necrotic and disappeared.

(f) Ligation of the veins alone: Examination at the end of one to 120 days showed marked pathologic changes in every instance. The muscle becomes swollen, hard, dark blue, and paralyzed: and then follow great extravasation of blood into the muscle, accumulation of polymorphonuclear leucocytes, and necrosis of many muscle fibers; then marked connective tissue proliferation and degeneration of muscle fibers, proceeding to a fibrosis, in the midst of which are usually some muscle fibers which preserve slight contractility but which may be so extensive as to crowd out all muscle fibers. The fibrosed muscle then invariably became contractured.

The results in this occlusion of the vein from a muscle isolated from the surrounding tissues were always the same, *viz.*, an inflammatory stage followed by an extensive fibrosis.

The author reasons that the primary cause of this is probably mechanical—raising the blood pressure high enough to destroy the capillary system, thereby interfering sufficiently with the nutrition of the tissues to produce degeneration or necrosis, accompanied by an inflammatory reaction. Marked obstruction to return of blood from tissues to which the arterial flow is not obstructed produces inflammatory rather than degenerative changes. Degeneration is present but does not involve all the tissues of the muscle and is overshadowed by the inflammation and subsequent proliferation of connective tissue. This proliferation continues for several weeks and the end-result is the conversion of the muscle into a mass of fibrous tissue.

The author concludes that the classic picture of Volkmann's ischemic paralysis can be explained only on the basis of an acute venous obstruction.—*C. L. Lowman, M.D., Los Angeles.*

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CASE OF MYOSITIS OSSIFICANS PROGRESSIVA IN A CHILD. J. A. Henderson. *Edinburgh Med. Jour.*, September, 1922.

In this child, a female, the mother first noticed evidence of the disease when the child was two weeks old in the appearance of a swelling in the left sternomastoid muscle, which developed a torticollis and became bony in part. Following this were other swellings on the head, the back of the neck, the anterior bellies of the digastric muscles, and in the pectoral muscles. It was early observed that the great toes were short. Henderson summarizes the characteristics of this disease as follows:

1. The disease is characterized by periods of quiescence, alternating with "acute phases," during which the slightest trauma produces the swelling described.

2. The disease is present at birth, but does not manifest itself until the acute phase is present.

3. The swellings themselves are apparently of the nature of an acute myositis, with subsequent increase of connective tissue and fibrous transformation of the muscle. Bone may form or the swelling may disappear.

4. Characteristic deformity of great toes and sometimes of thumbs is present from birth.

5. The muscles chiefly affected are those of the scalp, neck, trunk, limbs, and masseters, leaving unaffected hands, feet, muscles of expression, external eye muscles, muscles of pelvis and genital organs, the sphincters, and all unstriped muscles. No treatment is effective.

6. No rise of temperature has been noted in the case.—*C. A. Parker, M.D., Chicago.*

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ON THE ETIOLOGY OF PERTHES' DISEASE. N. Rehbein. *Deutsche Ztschr. f. Chir.*, 1922, September, 1922.

Dolle could assemble only thirty-eight cases from the world's literature of traumatic dislocation of the hip in childhood. Author saw a case of Perthes' disease, which, by its development on the basis of a traumatic luxation, is especially interesting. The case is of an eight-year-old child who fell on the ice, and when seen the same day showed by x-ray a dislocated hip. After re-

duction and convalescence the patient was discharged with an apparently normal hip. Patient returned a year later with a painful knee on the affected side and a limp. On x-ray examination Perthes' disease of the hip was disclosed. Trauma as a cause of Perthes' disease has been discounted by Brandes on the basis that the injury was usually too slight, and congenital disturbances of development have been made the disposing factors. Author feels that Brandes has gone too far in his leaning away from trauma, and points to the case just cited as proving that trauma alone can produce Perthes' disease in a thoroughly normal head of the femur. He believes the reduction, because of the ease with which it was accomplished, was not a factor here in producing the Perthes' disease. The mechanics of the injury also answers for an injury of the ligamentum teres, therefore explaining a secondary deforming process following a vascular injury.—*Armin Klein, M.D., Boston.*

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SPRAINS OF RHOMBOIDEUS MINOR MUSCLE: STUDY OF ONE HUNDRED AND FIFTY INJURIES OF SHOULDER GIRDLE. J. P. Replogle. *Annals of Surgery*, November, 1922.

A diagnosis of "sprain of the shoulder" is too frequently made without attempting to make a more definite diagnosis. The term sprain is too evasive. In an analysis of 150 successive cases of shoulder injuries observed at the Cambria Steel Company Hospital, 26 varieties of lesions were noted. Contusions, 30 per cent.; sprains of various muscle groups or individual muscles, 25 per cent.; dislocations and fractures, 18 per cent.; subacromial bursitis, six per cent. Sprain of the rhomboideus muscle is more frequent than any other traumatic lesion of the shoulder, excluding severe contusions. The sprain occurs during the performance of heavy labor—swinging a sledge, firing a furnace, etc. A sudden knife-like, stabbing pain just median to the base of the spine of the scapula occurs. Pain lasts for a quarter of an hour, returns in the evening and occurs on motion, subsequently. A very definite localized point of tenderness about the size of a quarter is noted just internal to the base of the spine of the scapula. The arm cannot be abducted beyond 90 degrees without the production of pain.

In treating these cases the shoulders are thrown back and are maintained in this position by criss-cross adhesive straps. The arm is placed in a sling and a pad placed under the adhesive, over the point of tenderness, to possibly hasten the absorption of the serous effusion at the point of rupture.

The treatment, therefore, is simple and is efficacious.—*E. Z. Holt, M.D., Atlantic City, N. J.*

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NEUROPATHIC ARTHROPATHIES: CHARCOT'S SPINE. John Ridlon and E. J. Berkheiser. *Jour. Amer. Med. Assn.*, October 28, 1922, p. 1467.

Ten cases are reported and a number of skiagraphs shown. The symptoms, complications, prognosis, and treatment are taken up and the differential diagnosis from tuberculosis, hypertrophic arthritis, malignant disease, compression fracture, typhoid spine, and Paget's disease is very carefully gone into.

This condition occurs most often in males and in any region of the spine; bony changes are destruction, proliferation, and displacement, usually laterally. Treatment: Plaster or leather jackets with active anti-syphilitic medication.—*Edward S. Hatch, M.D., New Orleans.*